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Research Document 2002/096 | **Document de recherche 2002/096**

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An assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps in October 2002

Évaluation du stock de morue (*Gadus morhua*) dans la sous-division 3Ps de l'OPANO en octobre 2002

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Abstract

This document summarizes scientific information used to determine the status of the cod stock in NAFO Subdivision 3Ps off the south coast of Newfoundland. The current assessment provides revised estimates of the abundance of fish on 1 April 2002. Numbers-at-age are projected to 1 April 2003 by accounting for recorded catch up to the end of August 2002 and assumed catch for the remainder of the season to 31 March 2003. A deterministic medium term (3 yr) projection was also conducted, where numbers were projected to 31 March 2006 under a range of TAC options. Sources of information available for this assessment were: reported landings from commercial fisheries (1959-March 2002), oceanographic data, a time series (1973-2002) of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom-trawl surveys, an industry offshore bottom-trawl survey, inshore sentinel surveys (1995-2001), science logbooks from vessels <35ft (1997-2001), logbooks from vessels >35ft (1998-2001), and tagging studies (1997-2002). The fishery was still in progress at the time of the assessment and complete information on catch rates and age compositions from the 15,000 t TAC from 1 April 2002 – 31 March 2003 was not available. Several sequential population analyses (SPA) were carried out using reported commercial catches, calibrated with Canadian RV survey data, standardized annual catch rate-at-age indices for line-trawl and gillnet from the sentinel survey, and industry trawl survey data. In some SPA runs, the RV surveys were treated as two indices, one for the eastern and one for the western portion of the stock area, as described in Brattey et al. (2000). Spawner biomass estimates for 1 April 2003 from the various SPA formulations considered covered a wide range, and no single SPA run was considered to best represent absolute population size; however, estimated trends in spawner biomass were similar. All the SPA's indicated that spawner biomass increased during 1993-1998, declined during 1999 to 2001 and increased slightly in 2002. As observed in the previous assessment, the 1997 and 1998 year classes appear to be stronger than those produced during 1991-1996 and these year classes are now entering the fishery. The medium term (3 yr) projection indicated that the spawner biomass is expected to be higher in 2005 compared to 2002 under TAC options of 10,000 t, 15,000 t and 20,000 t. The medium term projection does not take into account any uncertainties, such as those associated with the stock composition of the commercial catch, misreported catches and assumptions about natural mortality. The trends in the 3 yr projection depend heavily on the accuracy of the estimates of the 1997-1999 year classes and their subsequent survival and recruitment to the fishery in 2003-2005.

Résumé

Dans ce document, nous résumons les données scientifiques utilisées pour déterminer l'état du stock de morue dans la sous-division 3Ps de l'OPANO, située au large de la côte sud de Terre-Neuve. L'évaluation fournit des estimations révisées de l'abondance de la morue au 1er avril 2002. Nous faisons une projection de l'abondance par âge au 1er avril 2003 en tenant compte des prises signalées jusqu'à la fin d'août 2002 et des prises supposées pour le reste de la saison, soit jusqu'au 31 mars 2003. Nous avons aussi effectué une projection déterministe à moyen terme (trois ans, soit au 31 mars 2006) selon diverses options de TAC. Voici les données utilisées pour l'évaluation : débarquements signalés des pêches commerciales de 1959 à mars 2002, données océanographiques, une série chronologique (1973-2002) d'indices d'abondance et de biomasse obtenus par des relevés au chalut de fond effectués à l'hiver ou au printemps au moyen d'un navire de recherche (NR) canadien, ainsi que des données d'un relevé au chalut de fond effectué au large par l'industrie, de pêches indicatrices côtières (1995-2001), des registres de pêche des bateaux < 35 pi (1997-2001 et des bateaux > 35 pi (1998-2001) et d'expériences de marquage (1997-2002). Au moment de l'évaluation, la pêche était encore en cours, et les données complètes de taux de capture et de composition par âge pour le TAC de 15 000 t couvrant la période allant du 1er avril 2002 au 31 mars 2003 n'étaient pas disponibles. Nous avons effectué plusieurs analyses séquentielles de population (ASP) à l'aide des prises commerciales signalées et étalonnées par rapport aux données de relevés de NR, des indices normalisés des taux de capture annuels par âge des pêches indicatrices à la palangre et au filet maillant et des données de relevé au chalut de l'industrie. Dans certaines ASP, nous avons traité les données des relevés de NR comme deux indices, un pour la partie est de la zone de stock et un pour la partie ouest, tel que décrit par Brattey et al. (2000). Les estimations de la biomasse de géniteurs au 1er avril 2003 obtenues par les diverses variantes de l'ASP variaient considérablement, et aucune ASP n'a été considérée comme meilleure pour donner une taille absolue de la population. Par contre, les tendances estimées de la biomasse des géniteurs étaient semblables : toutes les ASP montraient que la biomasse des géniteurs a augmenté de 1993 à 1998, diminué de 1999 à 2001, puis augmenté légèrement en 2002. Comme on l'a observé lors de l'évaluation précédente, les classes d'âge 1997 et 1998, qui sont actuellement recrutées à la pêche, semblent plus fortes que celles de 1991 à 1996. Selon les projections à moyen terme (trois ans) effectuées pour des options de TAC de 10 000 t, de 15 000 t et de 20 000 t, la biomasse des géniteurs devrait être plus élevée en 2005 qu'en 2002. Cette projection ne tient compte d'aucune incertitude, comme celles liées à la composition des prises commerciales, aux prises mal ou non signalées et aux suppositions concernant la mortalité naturelle. Les tendances obtenues pour la projection sur trois ans dépendent beaucoup de l'exactitude des estimations des classes d'âge 1997, 1998 et 1999, de leur survie et de leur recrutement à la pêche de 2003 à 2005.

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1. Introduction

This document gives the results of the regional assessment of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps conducted in St. John's, Newfoundland during 15-25 October 2002. Following a 4 year moratorium that began in August 1993, the directed cod fishery in this area was reopened in May 1997 with a total allowable catch (TAC) set at 10,000 t. The TAC was subsequently increased to 20,000 t for 1998 and to 30,000 t for 1999. In addition, an interim TAC of 6,000 t was set for the first 3 months of year 2000 to initiate a new management year beginning 1 April 2000 and ending 31 March 2001. The TAC for 1 April 2000 – 31 March 2001 was set at 20,000 t and the TAC for the next two management years (1 April 2001 – 31 March 2002 and 1 April 2002 – 31 March 2003) was set at 15,000 t.

The history of the cod fishery in NAFO Subdivision 3Ps, located off the south coast of Newfoundland (Figs. 1, 2), and results from other recent assessments of this stock, are described in detail in previous documents (Pinhorn 1969; Bishop et al. 1991, 1992, 1993, 1994, 1995; Shelton et al. 1996; Stansbury et al. 1998; Brattey et al. 1999a, b, 2000, 2001a).

The present assessment incorporates all available information on 3Ps cod, including the April 2002 research vessel bottom-trawl survey data and a portion of the 2002 catch-at-age data from the commercial fishery, which was still in progress at the time of the assessment meeting. Detailed information on catch-at-age up to the end of March 2002 was available and preliminary catch information up to 1 October 2002 was also used in the assessment. Additional sources of information included: oceanographic data (Colbourne 2003), science logbooks for vessels <35ft (1997-2001), industry logbooks for vessels >35ft (1998-2001), an industry trawl survey on St. Pierre Bank (1997-2001)(McClintock 2002), inshore sentinel surveys (1995-2001), and recaptures of tagged cod (received up to 30 September 2002) from tagging experiments conducted during 1997-2002.

In the current analyses it was assumed that the entire 15,000 t TAC would be taken in the fishing season from 1 April 2002 to 31 March 2003, as outlined in the management plan released by DFO prior to the start of the season. The current assessment provides a revised estimate of the abundance of fish on 1 April 2002. Numbers at age are first projected to 1 April 2003 by accounting for recorded catch up to the end of August 2002 and assumed catch for the remainder of the season to 31 March 2003. In a second step, a deterministic medium term (3 yr) projection was conducted, where numbers were projected to 31 March 2006 under a number of TAC options.

2. Environmental overview

Water mass characteristics in the 3Ps region are largely determined by the general circulation, which consists of Labrador Current Water, the inshore branch of which flows through the Avalon Channel, and around Cape Race. This branch then divides into two parts, one flowing to the west around the north of St. Pierre Bank, and the other flows to the south between Green Bank and Whale Bank. Additionally, part of the offshore branch of the Labrador Current flows around the tail of the Grand Bank, westward along the continental slope (where it may interact with the Gulf Stream and slope waters), to the Laurentian Channel and into the Gulf of St. Lawrence. As a result the near-bottom habitat in the 3P region can be divided into two distinct oceanographic regimes. One influenced by cold-fresh water from the eastern Newfoundland Shelf, which includes much of St. Pierre Bank and regions to the east. In this region temperatures generally range from 0-2°C but are

often <0°C in many years. The other includes the deeper regions of the Laurentian and Hermitage Channels and areas to the west of St. Pierre Bank. This region appears to be influenced mostly by warmer slope water from the south. As a result this region experiences high variability with temperatures ranging from 3-6°C.

Oceanographic data from NAFO subdivisions 3Pn and 3Ps obtained from the multi-species surveys during the spring of 2001 and 2002 are examined and compared to the long-term (1971-2000) average (Colbourne 2003). The temperature and salinity data were examined in several ways: as vertical sections across major banks and channels, spatial bottom maps, time series of areal extent of bottom water in selected temperature bins and as time series of temperature and temperature anomalies. Temperature measurements on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to mid 1990s. However, beginning around 1996 temperatures started to moderate, decreased again during the spring of 1997 and returned to more normal values during 1998. During 1999 and 2000 temperatures continued to increase, reaching the highest values observed since the late 1970s in some regions. During the spring of 2001 and 2002 temperatures cooled significantly over the previous two years to values observed during the mid-1990s. The 2002 values were slightly higher than those reported in 2001. The areal extent of <0°C bottom water increased significantly from the mid-1980s to mid-1990s but decreased to very low values during 1998-2000. During 2001 the extent of this cold area increased to values observed during the mid-1990s, then decreased slightly during 2002. Since 1995 the areal extent of bottom water with temperatures >1°C has been increasing, reaching pre-1985 values during 1999-2000. During 2001 this area of >1°C decreased significantly compared to the previous 3-years, but during 2002 it increased marginally. On St. Pierre Bank (SPB) <0°C water completely disappeared during the warm years of 1999 and 2000. It has since increased to between 20-30% of the area of SPB during 2001 and 2002. The area of near-bottom water on the banks with temperatures >1°C was about 50% of the total area during 1998, the first significant amount since 1984. This subsequently increased to about 70% during 1999 and to 85% during 2000 but decreased to low values during the past 2 years. In general, temperature conditions in this region during the spring of 2002 were cold on the banks but increased slightly over values observed in 2001, while salinity values were fresher than those observed in 2002.

3. Commercial catch

Catches (reported landings) from 3Ps for the period 1959 to 1 October 2002, by country and separated for fixed and mobile gear, are summarized in Table 1 and Figs. 3a and 3b. Canadian landings for vessels <35 ft were estimated mainly from purchase slip records collected and interpreted by Statistics Division, Department of Fisheries and Oceans prior to the moratorium. Shelton et al. (1996) emphasized that these data may be unreliable. Post-moratorium landings for vessels <35 ft have come mainly from a new dock-side monitoring program. Landings for vessels >35 ft come from logbooks. Non-Canadian landings (mainly France) are compiled from national catch statistics reported by individual countries to NAFO and there is generally a lag in the submission of final statistics; consequently, the most recent entries in Table 1 are designated as provisional.

The stock in the 3Ps management unit was heavily exploited in the 1960's and early 1970's by non-Canadian fleets, mainly from Spain and Portugal, with reported landings peaking at about 87,000 t in 1961 (Table 1, Fig. 3a). After extension of jurisdiction (1977), cod catches averaged between 30,000 t and 40,000 t until the mid-1980's when increased fishing effort by France led to increased total landings, reaching a high for the post-extension of jurisdiction period of about

59,000 t in 1987. Subsequently, catches declined gradually to 36,000 t in 1992. Catches clearly exceeded the TAC throughout the 1980's and into the 1990's. The Canada-France boundary dispute led to fluctuations in the French catch since the late 1980's. A moratorium was imposed on all directed cod fishing in August 1993 after only 15,216 t had been landed, the majority being taken by the Canadian inshore fixed gear fishery. In this year access by French vessels to Canadian waters was restricted. Under the terms of the Canada-France agreement, France is allocated 15.6% of the TAC, of which Canadian trawlers must fish 70%, with the remainder fished by small inshore fixed gear vessels.

In 1997, 72% of the 10,000 t TAC was landed by Canadian inshore fixed gear fishermen, with most of the remaining catch taken by the French mobile gear sector fishing the offshore (Table 1, Fig. 3b). In 1998, approximately 57% the 20,000 t TAC was taken by the Canadian inshore fixed gear sector, with 34% taken by the Canadian and French mobile gear sectors fishing the offshore. In 1999, over 21,230 t or approximately 71% of the TAC was taken by the Canadian inshore fixed gear sector, with most of the remainder taken by Canadian and French mobile gear sectors fishing offshore. During the first three months of 2000, there were substantial landings from both the Canadian and French mobile gear sectors fishing the offshore (1,544 t and 2,460 t, respectively). The Canadian inshore fixed gear sector reported landings of 3,301 t during this period. During the 2000 calendar year, total reported landings were 25,100 t of which 68% was landed by the inshore fixed gear sector and most of the remainder (29%) by the offshore mobile gear sector. During 2001, total reported landings decreased to 16,510 t with the inshore fixed gear sector accounting for 72% of the total. In the 2002 calendar year to 1 October, the inshore fixed gear sector accounted for 77% of the reported landings; the mobile gear sector typically catches most of its allocation in the late fall and early winter.

Line-trawl catches dominated the fixed gear landings over the period 1977 to 1993, reaching a peak of over 20,000 t in 1981 (Table 2, Fig. 4). In the post-moratorium period, line-trawls have accounted for 14 to 23% of the fixed gear landings. Gillnet landings increased steadily from 1978 to a peak of over 9,000 t in 1987, but declined thereafter until the moratorium. Gillnets have been responsible for the dominant portion of the inshore catch since the fishery reopened in 1997, with gillnet landings exceeding 10,000 t (i.e. 50% of the TAC) for the first time in 1998, and approaching 18,000 t in 1999. Gillnet landings dropped substantially in 2001, partly due to a management restriction in their use that was removed part way through the fishery following extensive complaints from industry. Gillnets are also being used extensively in the offshore areas in the post-moratorium period (see below). Trap catches have varied over the time period, but have not exceeded 8,000 t and have declined from 1,167 t to negligible amounts from 1998 onwards. Hand-line catches have been a minor (<3,000 t) component of the fishery prior to the moratorium and accounted for a small fraction of landings during 1998-2000; however, the hand-line catch for 2001 shows a substantial increase (to 17% of total fixed gear) over the 1998-2000 period.

Landings during 2001 and up to 1 October 2002 are summarized by month, for inshore and offshore, and for each gear type separately, in Table 3a. Inshore catches in 2001 have come mostly from gillnets with substantial landings in all months except February-May. Line-trawls were fished inshore mostly during June-December. In the offshore, otter trawl (and Norwegian seine) fishing by Canadian trawlers and vessels chartered by St. Pierre and Miquelon to fish the French allocation was concentrated mainly during the first and last quarters of the year. As in 2000, there was also a substantial offshore gillnet catch in 2001 with landings totaling over 2,000 t taken mostly during July-November. Overall, landings in 2001 were dominated by the directed gillnet fishery with the remaining catch taken by otter trawl, followed by line-trawl and hand-line,

with negligible amounts taken by trap. Preliminary landings for 2002 show similar trends to those seen for the corresponding period in 2001.

The landings for the 2001 calendar year and the first nine months of 2002 are summarized by month and unit area in Table 3b and for the 2000/2001 management year in Table 3C. In contrast to 2000, there were less inshore landings in first three months of 2001. Inshore landings in February-April 2001 and February-April 2002 were low and came mostly from by-catch fisheries. Landings increased in the inshore unit areas during June and July 2000. In Placentia Bay (3Psc) landings of over 1,200 t were reported in July alone in 2001 and 2002. Landings from inshore areas tended to be lower in August 2001 and August 2002, but increased in September-November in 2001. As in previous years, there were substantial landings (1,386 t) in Placentia Bay during November 2001. In the offshore, landings tended to be higher in fall and winter and lower during the summer months (June-August). Overall, preliminary landings for the 2002 calendar year show similar spatial and temporal trends to those seen in 2001.

The distribution of post-moratorium catches among unit areas is illustrated in Fig. 5. The inshore (3Psa, 3Psb, and 3Psc) has consistently accounted for most of the reported landings. The landings have typically been highest in Placentia Bay (3Psc), ranging from 4,000 t to almost 12,000 t with typically 30-50% of the entire TAC coming from this unit area alone. Landings from 3Psa and 3Psb have been fairly consistent at about 1,000-3,000 t and generally 5-12% and 9-22% of the TAC, respectively. Most of the offshore landings have come from 3Psh and 3Psf (Halibut Channel and the southeastern portion of St. Pierre Bank).

The 1 April 2002 to 31 March 2003 conservation harvesting plan placed various restrictions on how the 3Ps cod fishery could be pursued. Unit area 3Psd has remained closed to directed cod fishing from 15 November to 15 April since 1998, due to possible mixing of northern Gulf cod into the 3Ps stock area at this time of year. From 1997 to 31 March 2001, fishers with homeports west of the Burin Peninsula fished competitively with quarterly quotas, but an IQ system was introduced in this area starting in the 2001/2002 management year and this was continued in 2002/2003. In contrast, fishers in Placentia Bay have operated under an individual quota (IQ) system since 1998. A dockside monitoring system was introduced following the reopening of the fishery, and other restrictions, many of which varied according to vessel class, have included the amount of gear that could be fished, where fish could be landed, trip and weekly limits, and a small fish limit. Mesh size of gillnets was also restricted to a maximum of 6.5 inches. During the 2001 management year, use of gillnets was initially restricted to 40% of the vessel IQ with the remainder to be caught by hook and line (hand-line or long-line) and gillnets were no longer permitted after September. The 40% restriction was imposed in an attempt to reduce discarding resulting from prolonged soak times when nets could not be retrieved in adverse fall weather. However, the restriction was lifted during mid-October following extensive complaints from industry. As in previous years, the 6.5" mesh limit in the directed cod fishery could be circumvented by gill-netters fishing the offshore portion of 3Ps because they could use much larger mesh size (8" and 10"), and more gillnets, when fishing for other species such as skate and white hake and still keep cod as by-catch.

3.1 Catch-at-age

Samples of length and age composition of catches were obtained from the inshore trap, gillnet, line-trawl and hand-line fisheries and the offshore otter trawl, gillnet, and line-trawl fisheries by port samplers and fishery observers. Sampling of the catch in 2001 was intensive, with 7,164 otoliths collected for age determination and over 77,937 fish measured for length (Table 4A). The sampling was well distributed spatially and temporally across the gear sectors. Substantial landings in summer from inshore fixed gears (see Table 3) were sampled intensively, particularly line-trawl and gillnet. The smaller number of samples from the offshore line-trawl catch reflects the smaller catches from these gears in 2001. Sampling during January-March 2002 has also been intensive with 947 otoliths collected for age and 12,089 fish measured for length (Table 4b) from the offshore otter trawl and inshore gillnet and inshore linetrawl catches (see Table 3b).

The age composition and mean length-at-age of commercial catches were calculated as described in Gavaris and Gavaris (1983). The average weights were derived from a standard length-weight relationship where log(weight)=3.0879*log(length)-5.2106. Catch-at-age for all gears combined based on sampling of Canadian and French vessels in 2001 and January to March in 2002 is summarized in Tables 5a, 5b, Table 6 and Fig. 6. In the 2001 landings from all gears combined, ages 4 to 9 were well represented (1992 to 1997 year classes) with age 7 (1994 year class) the most abundant overall. The age composition of the catch from the first three months of 2002 showed a somewhat different age composition to that of the preceding year, with ages 5-9 predominating.

Catch at age by gear type for 2001 and January-March 2002 is illustrated in Fig. 7. The dominance of gillnet selectivity on ages 6 to 9 is apparent in both years. In comparison, line-trawls selected younger fish, mostly ages 4 to 7. Offshore mobile gear accounted for most of the landings in January-March 2002 with ages 5-9 predominating as well as ages 12-13 (i.e. 1989 and 1990 year classes). The catch for the first 3 months of 2002 for some gears, notably line-trawl, is quite small (see Table 3a).

A time series of catch numbers-at-age for the 3Ps cod fishery from 1959 to 2001 is given in Table 6. For the 2001 fishery, 6-7 year-old cod (1995 and 1994 year class) dominated the final catch although in terms of numbers 4-9 year olds are also well represented.

Mean annual weights-at-age in the commercial catch in 3Ps (including food fisheries and sentinel survey catches), calculated from mean lengths-at-age, are given in Table 7a and Fig. 8a. Beginning of the year weights-at-age, calculated from commercial mean annual weights-at-age as described in Lilly (1998), are given in Table 7b and Fig. 8b. Current weights of younger fish (3-6) tend to be higher than those reported for the 1970's and early 1980's, whereas for older fish the converse is true. Sample sizes for the oldest age groups (>10) have been low in recent years due to scarcity of old fish in the catch. Furthermore, as Lilly et al. (1999) point out for 2J3KL cod, interpretation of these trends is difficult because of changes in the relative contribution of various gear components and changes in the location and timing of catches. The higher proportion of gillnet landings in 3Ps, particularly in 1998 and 1999, could increase the mean weight-at-age of the younger ages, because only the fastest-growing, largest individuals within a cohort would be caught by this gear.

For projections of stock size in coming years (see Section 9.3), mid-year weights-at-age and Jan. 1 weights-at-age were calculated as follows. For mid-year weights-at-age in 2002, the weight-at-age of cod of age a in 2001 was projected to age a+1 in 2002 by assuming that the cohort would

grow (from the size attained by 2001) at the average rate experienced over the same age span by the previous 4 cohorts. The Jan. 1 weights-at-age in 2002 were calculated from the mid-year weights-at-age in the manner described above. The Jan. 1 weights-at-age in 2003 were projected from the Jan. 1 weights-at-age in 2002 using the procedure described above for the mid-year weights. This procedure of projecting the size of each cohort from the size already attained had not been attempted before, and it was thought that perhaps it would be prudent to see how well it performed before projecting further into the future. Therefore, mid-year weights-at-age for 2003-2005 were set equal to the average mid-year weights-at-age during the years 1997-2001, and Jan. 1 weights-at-age for 2004-2005 were set equal to the average Jan. 1 weights-at-age during the years 1997-2001.

4. Sentinel survey

The sentinel survey has been conducted in 3Ps since 1995 and there are now seven complete years of catch and effort data (see Maddock-Parsons and Stead 2001) and collection of data for the eighth year is in progress. During 2002 the sentinel survey continued to produce a time series of catch/effort data and biological information collected by trained fish harvesters at various inshore sites along the south coast of Newfoundland. There were 16 active sites in 3Ps, using predominantly gillnets (5½ " mesh) in unit area 3Psc (Placentia Bay) and line-trawls in 3Psb and 3Psa (Fortune Bay and west). One 3¼ " gillnet is also fished at each of 4 sites in Placentia Bay one day per week. Fishing times averaged 10 weeks in 2001 and 2002, 9 weeks in 2000 as opposed to 6 weeks in 1999 and 12 weeks from 1995-1998. Most fishing takes place in fall/early winter. Maddock-Parsons and Stead (2002) produced an updated time series of weekly average catch rates and annual relative length frequencies (number of fish at length divided by amount of gear). Catch rates for both gill nets and line-trawl in 2001 were generally similar to or marginally lower than those reported for comparable times in the preceding year. Based on preliminary data, catch rates in 2002 for line-trawl appear similar to 2001, with only one site showing an increase over the previous year. Catch rates for 5½ " gill nets in 2002 were generally similar to or marginally lower than those for 2001. Catches in 2002 and are again composed mainly of smaller fish.

As in previous assessments, an attempt was made to produce an age dis-aggregated index of abundance for the seven completed years in the gillnet (5½ " mesh) and line-trawl sectors of the program; there is insufficient data from the 3¼ " gillnets to develop an index for this gear. Sentinel fishers typically fish a control and an experimental site; the location of the control site is fixed, whereas the location of the experimental site can change only within the local area.

4.1 Standardized sentinel catch rates

The catch from 3Ps was divided into cells defined by gear type (5½" mesh gillnet and line-trawl), area (unit areas 3Psa, 3Psb, 3Psc), year (1995-2001) and quarter. Age-length keys were generated for each cell using fish sampled from both the fixed and experimental sites; however, only fish caught at the fixed sites were used to derive the catch rate indices. Length frequencies and age-length keys were combined within cells. The numbers of fish at length are assigned an age proportional to the number at age for that particular cell length combination. Fish that were not assigned an age because of lack of information within the initial cell were assigned an age by aggregating cells until the data allowed an age to be assigned. For example, if there are no sample data in a quarter then quarters are combined to half-year, half-years are combined to year; if an

age still cannot be assigned, then areas are combined for the year.

Catch-at-age and catch per unit effort (CPUE) data were standardized using a generalised linear model to remove site and seasonal effects. For gillnets, only sets at fixed sites during July to November with a soak time between 12 and 32 hours were used in the analysis. For line-trawl, sets at fixed sites during August to November with a soak time less than or equal to 12 hours where used in the analysis. Zero catches were generated for ages not observed in a set. Sets with effort and no catch are valid entries in the model. Note that catch rates from the sentinel fishery are expressed in terms of numbers of fish, rather than catch weight as was used in the analyses of logbook data. This has important implications when comparing trends in these indices.

A generalized linear model (McCullagh and Nelder 1989) was applied to the sentinel catch and effort data for each gear type. The response distribution was specified as Poisson and the link function was chosen to be log. That is, the Poisson mean parameter μ_i is related to the linear predictor by

$$\log(\mu_i) = X_i'\beta$$

where X_i' is a vector of explanatory factors for catch observation I (i.e. month, site age and year) and β is a vector of coefficients to be estimated from the data.

Thus catch is assumed to have a Poisson probability distribution with the mean μ_i related to the factors month nested within site and age nested within year by

$$\log(\mu_i) = \log(E_i) + month_i(j)\beta_j(site_i(k)\beta_k) + age_i(l)\beta_l(year_i(m)\beta_m),$$

where E_i is and offset parameter for fishing effort and j,k,l,m indicate the level for each of the four factors.

In the present assessment, the model adequately fitted data from gillnets and line-trawls and two standardized annual catch rate-at-age indices were produced, one for each gear type. All effects included in the model were significant. The standardised gillnet and line-trawl catch rate-at-age indices for 1995 to 2001 are given in Table 8. For gillnets, the catches during 1995-1997 were dominated by the 1989 and 1990 year-classes and for the subsequent period the 1992 year-class is well represented, although catch rates for the latter do not appear to be as strong. In 2001, the 1997 and 1998 year classes appear strong although these fish are still rather small to be caught effectively by 5½ " mesh. For line-trawls, catch rates were higher for the 1989 and 1990 year-classes during 1995 to 1996 followed by the weaker 1992 year-class. A notable finding is the relatively strong appearance of 3 year and 4 year old fish (1996 and 1997 year-classes) in the 2000 and 2001 line-trawl catches, and the 1998 year class in the 2001 line-trawl catches. Overall, both indices are reasonably consistent; the relatively strong 1989 and 1990 year classes have passed through the fishery and been by replaced weaker year classes from the mid-1990s, with stronger year-classes from the late 1990's now appearing in catches.

Annual trends in standardized total (ages 3-10 combined) annual catch rates, expressed in terms of numbers of fish, are shown in Fig. 9. For gillnets there is no trend over the period 1995-1997, but catch rates are progressively lower in 1998, 1999 and 2000 and remained low in 2001. For line-trawls, catch rates show a decline from 1996 to 1997, but have been relatively stable from 1997 to 2001. As described in recent 3Ps cod assessments, commercial fisheries during 1997-2001 may have had some disruptive influence on the execution of the sentinel fishery. Competition with commercial fishers for fishing sites, local depletion, inter-annual changes in the

availability of fish to inshore, and shifts in the timing of sentinel fishing to accommodate periods of commercial fishing could all influence mean catch rates between years. The extents to which such effects influence catch rates are not fully understood. The decline in sentinel gill net catch rates since the fishery re-opened continues to be interpreted as cause for concern. These declines are consistent with the inshore catch rate data from science log-books and the high estimates of exploitation from tagging in Placentia Bay.

5. Science logbooks

A new science logbook was introduced to record catch and effort data for vessels less than 35 ft in the re-opened fishery in 1997. The purpose of this logbook is for scientific stock assessments and not for quota monitoring or other controls on the fishery. Previously only purchase slip records were available for these size vessels, containing limited information on catch and no information on effort. Catch rates have the potential to provide a relative index of temporal and spatial patterns of fish density, which may relate to the overall biomass of the stock. There are currently data for more than 48,400 gillnet sets and 17,000 line-trawl sets directing for cod in the database. These data pertain to the inshore fishery, i.e. unit areas 3Psa, 3Psb, and 3Psc.

As in the previous assessment, effort was treated as simply the number of gillnets, or hooks for line-trawls (1000's), deployed in each set of the gear; soak times were not adjusted as the relationship between soak time, gear saturation and fish density is not known. Catch rates were expressed in terms of weight; catches are generally landed as head-on gutted and recorded in pounds; these were converted to kg by multiplying by 2.2026.

As observed in previous assessments, preliminary examination of the logbook data indicated that soak time for gillnets is most commonly 24 hours with 48 hours the next most common time period. In comparison, line-trawls are typically in the water for a much shorter period of time – typically 2 hours with very few sets more than 12 hours. In addition, the distribution of catches per set is skewed to the right for most gears (not shown). For gillnets, catches per set are typically 100-200 kg with a long tail on the distribution extending to 2 tons. The distribution of catches for line-trawls was similarly skewed.

In the 1999 and 2000 assessments, an exploratory analysis of science logbook data was conducted to investigate spatial and temporal trends in catch rates at the level of unit areas and lobster management areas (Brattey et al 1999a, b, 2000). At that time the science logbook data covered a period of only three years. However, in the current assessment 5 years of data were available and an attempt was made to develop a catch rate index from these data. The same generalised linear model approach to that described above for the sentinel fishery was adopted, except that age composition data were not directly available for the logbook data so that the age effect is dropped. In addition, catch rates from logbooks were expressed in terms of weight, whereas sentinel catch rates were expressed in terms of numbers of fish. In a similar approach to that adopted for the sentinel survey data, the response distribution was specified as Poisson and the logarithmic link function was used.

The catch from 3Ps was divided into cells defined by gear type (gillnet and line-trawl), statistical area (numbered 29-37 and illustrated in Fig. 10a), and year (1997-2001). Catch per unit effort (CPUE) data were standardised to remove site and seasonal effects. Gillnet sets where the number of nets used was >30 were excluded to remove offshore gillnet activity from the analysis.

Similarly, line-trawl sets where the number of hooks was <100 or >4,000 were excluded. Sets with effort and no catch are valid entries in the model.

In the present assessment, the model adequately fitted data from gillnets and line-trawls and two standardized annual catch rate indices were produced, one for each gear type. All effects included in the model were significant. Preliminary analyses indicated that catch rates were generally higher for both line-trawl and gillnet in Placentia Bay compared to inshore areas further west. Overall, there has been a general downward trend in catch rates over time for both gear types (Fig. 10b). For gillnets, the catch rates have declined from 34 kg per net in 1997 to 14.0 kg per net in 2001. For line-trawls, catch rates were highest in 1997 at 301 kg per 1,000 hooks and have declined to around 199 kg per 1000 hooks in 2001.

The observed trends in commercial catch rate indices for the inshore fishery are influenced by many factors. There have been substantial annual changes in the management plans in the post-moratorium period, with respect to timing of the 3Ps cod fishery, amount of gear fished, trip and weekly limits, as well as a trend toward individual quotas (IQ's) rather than a competitive fishery. In addition, experience has shown that catch rates from mobile commercial fleets can be related more to changes in the degree of local aggregation of cod and be a poor reflection of overall trends in stock abundance, particularly for stocks in decline. While this is likely to be a bigger problem with respect to otter-trawl derived catch rates, gillnets and line-trawls can also be deployed to target local aggregations. For inshore fisheries, catch rates can also be strongly influenced by annual variability in the extent and timing of inshore as well as long-shore cod migration patterns. Similarly, the changes in management regulations, particularly the switch from a competitive fishery to IQ's can have a strong influence on catch rates that is unrelated to stock size. Consequently, inshore commercial catch rate data must be interpreted with caution. Where these data can be dis-aggregated into ages independently of the commercial catch at age data (as is the case with the sentinel survey) the information may be more easily interpreted in terms of stock size. Despite these issues, the declines in gillnet and line-trawl catch rates since the fishery re-opened in 1997 are cause for concern. The more stable catch rates for line-trawl in the past two years may, however, be reflecting the improved recruitment that is evident in other indices for the 3Ps stock (DFO RV survey, GEAC survey, sentinel indices).

6. Tagging experiments

A Strategic Project involving tagging of adult (> 45 cm) cod was continued during 2002 with an additional 8,263 tagged fish released in 3Ps up to 30 September 2002. Recoveries of tagged cod from the fishery are used to provide information on movement patterns and to estimate exploitation rates on cod tagged in different regions of the stock area. As in previous years single, double, and high-reward tags were applied, and tagging was conducted on spawning and pre- and post-spawning aggregations in the following areas: Halibut Channel (3Psh), Burgeo Bank-Hermitage Channel (3Psd), Fortune Bay (3Psb), and Placentia Bay (3Psc). Total numbers of cod released in 3Ps and reported as recaptured annually (up to 30 September 2002) from all areas combined are shown below.

Year released	Number tagged	1997	1998	1999	2000	2001	2002*
1997	6029	343	366	470	234	60	9
1998	9941		542	1065	552	179	25

1999	8450	.	.	654	813	285	43
2000	9900	.	.	.	687	771	108
2001	8363	.	.	.	.	714	171
2002	8263	.	.	.	.	.	107

Over 50,000 cod have been tagged and released in 3Ps since 1997, with approximately 6,000 to 10,000 cod released annually. Over 8,000 tagged cod have been reported as recaptured and a substantial database of recapture information now exists. In most years, typically about 5% to 8.5% of the initial releases are reported as recaptured in the year of release. A notable finding is that the largest number of reported recaptures is typically in the second year following release of tagged cod. In 1999, when reported landings were 28,111 t, over 10% of the releases in 1998 were reported as recaptured in the 1999 fishery. As landings have dropped in years subsequent to 1999 (see Table 1), fewer tagged cod have been reported as recaptured. In the 2001 calendar year, when landings were 16,510 t , 8.5% of the tagged cod released were reported as recaptured. Although the 2002 fishery is still in progress with approximately 9,000 t landed to 1 Oct 2002, the number of recaptures during 2002 appears to be considerably lower than in previous years.

6.1 Estimates of exploitation (harvest) rate

Brattey et al. (2001b, 2002) used data from post-moratorium tagging experiments to estimate annual exploitation rates for cod tagged in various regions of 3Ps. The number of reported recaptures from individual cod tagging experiments gives minimum estimates of the exploitation rates on the aggregations of cod that were tagged. However, in practice, not all fish survive tagging, some tags fall off the fish particularly in the first year, and not all recaptures of tagged fish are reported. Tagged (and untagged) cod also suffer natural mortality due to factors such as predation and disease. Accounting for these losses leads to a reduction in the number of tagged (and untagged) animals available to the fishery. As in Brattey et al. (2001b, 2002), information from companion studies was used to estimate these losses and include them when estimating exploitation. Double tagging was used to estimate tag loss rates and a high-reward tagging study was used to estimate reporting rates (Cadigan and Brattey 1999); tagging mortality was estimated by retaining batches of tagged cod in submersible enclosures (Brattey and Cadigan 2001). Exploitation rates were estimated for cod tagged in a specific area at a specific time (i.e. individual tagging experiments), irrespective of where recaptures came from. In this analysis no attempt was made to estimate population sizes using tag returns and commercial catches, because typically some harvesting occurs in an area different from where fish were tagged. This makes it difficult to convert local catches to local population biomass.

During 1999 and 2000, mean exploitation was high (0.22-0.25) for cod tagged in Placentia Bay (3Psc), intermediate (0.14-0.15) for cod tagged in Fortune Bay (3Psb), and low (0.04-0.06) for cod tagged in the Burgeo Bank – Hermitage Channel area (3Psd). During 2001, mean exploitation estimates declined slightly to 0.19 and 0.11 for Placentia Bay and Fortune Bay, respectively, whereas the estimate for Burgeo Bank - Hermitage Channel (3Psd) was largely unchanged (0.06). Note that the values reported here may have changed slightly from those reported in Brattey et al. (2001b); this is due to a slight change in the estimated reporting rate and recovery of additional tags from previous years. Values for 2002 for all experiments are preliminary as the fishery was still in progress

Mean exploitation was much lower (0.02 to 0.03) among cod tagged offshore (3Psh) throughout 1998-2001 in spite of substantial offshore landings. These low offshore exploitation rates are consistent with a large offshore biomass given the magnitude of recent offshore catches. However, the offshore estimates of exploitation are considered uncertain because of restricted offshore tagging coverage and restricted distribution of fishing activity in the offshore, greater uncertainty in the reporting rates of tags from the offshore and lower survival of fish caught for tagging offshore in deep (>200 m) water.

Cod stock structure within the 3Ps management unit is complex (Lear 1984, 1988; Brattey 1996 and references therein) and results from recent tagging and genetics studies have been used to investigate stock structure and seasonal movement patterns of 3Ps cod during the post-moratorium period (Beacham et al. 2002; Brattey 1999, 2000; Brattey et al. 1999b, c, 2000, 2001b; Ruzzante et al. 1998, 2000). Recaptures of tagged cod in 2001 and conclusions on stock structure from the most recent post-moratorium tagging experiments in 3Ps are described in Brattey et al. (2002).

7. GEAC Stratified Random Trawl Survey

In 2001, the Groundfish Enterprise Allocation Council (GEAC) carried out a fifth consecutive fall bottom-trawl survey directed at cod with the intention of creating a series of annual fall surveys in 3Ps to complement current DFO RV surveys conducted in spring. DFO provides advice on the stratified random design and catch sampling. Results of the previous surveys are reported in McClintock (1999a, b, 2000, 2001) and for the most recent survey in McClintock (2002). These surveys are carried out in November and December and cover a large portion of offshore 3Ps, but not the Burgeo Bank area (see McClintock 2000). The commercial trawler *M.V. Pennysmart* was used in all five surveys. Tows are of 30 min. duration using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined). The trawl was fitted with rock-hopper foot-gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using Scanmar net sensors (Netmind in previous years): bridge display of door-spread, opening, and clearance were recorded. No wingspread sensor was used in the 2001 survey and an assumed wingspread of 60 ft was used. The gear and configuration were identical in all four surveys. A total of 91 successful stratified random tow sets were completed in the 2001 survey. Three sets (#6, #42, and #78) were unsuccessful.

The Scanmar net monitoring instruments were deployed during the 2001 survey. Door-spread exhibited values varying from 11 to 85 m depending on depth. Mean door-spread and clearance values were similar to those in the 1999 and 2000 surveys, and the mean clearance in 2001 was 5.1 compared to 5.4 m in 2000 and 4.0 m in 1999. There has been considerable variability in some of the net parameters, particularly in the 2001 survey, suggesting some changes in net performance between strata and the causes of the variability should be investigated.

The mean cod catch per tow in 2001 was 50.5 fish with a mean catch weight of 95 kg. The latter value is substantially lower than was observed in the 2000 survey, whereas the mean number of fish per tow was similar to the 2000 value (45.3 fish per tow and 225 kg per tow, respectively). The largest catch of 1,376 cod weighing 2,504 kg was from set 37 in stratum 320 on St. Pierre Bank at a depth of 43 m. A total of 10 sets had catches over 100 kg, and two sets had catches over 1,000 kg. The mean cod weight for all sets was 1.87 kg per cod, substantially less than the mean for 2000 (>5.0 kg). Most of the larger catches were obtained from shallow strata on top of

St. Pierre Bank (strata nos. 314 and 320, see Fig. 11) and were comprised of fish whose mean weight was between 1 and 2 kg.

The 1997 trawlable biomass index was 99,330 t whereas the 1998 and 1999 estimates for a larger survey area were 47,875 t and 44,521 t, respectively. The trawlable biomass index for 2000 was 187,229 t, compared to 82,686 t in 2001.

In terms of age composition, the 1997 survey catch was dominated by 5 year olds (1992 year class) and 8-9 year olds (1990 and 1989 year class). In the 1998 survey 9 year olds dominated (1989 year class) and next most abundant were 5 year olds (1994 year). In the 1999 survey, the 1989 and 1990 year classes are well represented along with the 1992, 1993, and 1994 year classes. In the 2000 survey, the 1989, 1990, and 1997 year classes are strongly represented. In the 2001 and survey the 1997 and 1998 year classes are strongly represented. The 1991 year class is poorly represented relative to adjacent year classes in all five surveys.

Further information on the catches from the 2001 GEAC survey is given in McClintock (2002). The catch-rate-at-age information from the GEAC surveys (1997-2001) is included as an index in the sequential population analysis (see Section 9). Overall, the GEAC survey is showing considerable annual variability, similar to the DFO RV survey that covers a wider area but is conducted in spring. The age compositions of the catches from these surveys are in reasonably close agreement.

8. Research vessel survey

Stratified-random surveys have been conducted in the offshore areas of Subdiv. 3Ps during the winter-spring period by Canada since 1972, and by France for the period 1978-92. The two surveys were similar with regard to the stratification scheme used, sampling methods and analysis, but differed in the type of fishing gear and the daily timing of trawls (daylight hours only for French surveys). Canadian surveys were conducted using the research vessels *A.T. Cameron* (1972-82), *Alfred Needler* (1983-84), and *Wilfred Templeman* (1985-2002). From the limited amount of comparable fishing data available, it has been concluded that the three vessels had similar fishing power and no adjustments were necessary to achieve comparable catchability factors, even though the *A.T. Cameron* was a side trawler. The French surveys were conducted using the research vessels *Cyros* (1978-91) and *Thalassa* (1992) and the results are summarized in Bishop et al. (1994).

The stratification scheme used in the DFO RV bottom-trawl survey in 3Ps is shown in Fig 11. Canadian surveys have covered strata in depth ranges to 300 ftm since 1980. Five new inshore strata were added to the survey from 1994 (779-783) and a further eight inshore strata were added from 1997 (293-300). For surveys from 1983 to 1995, the Engel 145 high-rise bottom trawl was used. The trawl catches for these years were converted to Campelen 1800 shrimp trawl-equivalent catches using a length-based conversion formulation derived from comparative fishing experiments (Warren 1997; Warren et al. 1997; Stansbury 1996, 1997).

The Canadian survey results (in Campelen-equivalent units, see below) are summarized by stratum (Fig. 11) in terms of numbers (abundance) and biomass in Tables 9 and 10, respectively, for the period 1983 to 2002. Strata for which no samples are available were filled in using a multiplicative model. Timing of the survey has varied considerably over the period. In 1983 and 1984 the mean date of sampling was in April, in 1985 to 1987 it was in March, from 1988 to

1992 it was in February. Both a February and an April survey were carried out in 1993; subsequently, the survey has been carried out in April. The change to April was aimed at reducing the possibility that cod from adjacent northern Gulf (3Pn4RS) would erroneously be counted as part of the 3Ps stock. A portion of the Northern Gulf cod stock may cross the stock boundary into the Burgeo Bank area (see Fig. 1) and mix with 3Ps cod in winter in some years, mixing with the 3Ps stock and migrating back into the Gulf some time during the following spring. Campana et al. (1998, 1999, 2000) has suggested that mixing may be substantial and recent tagging studies suggest that it may extend into April in some years (Brattey et al. 2001b, 2002). However, the extent, timing, and duration of mixing are variable and have not been quantified on an annual basis.

8.1 Abundance, biomass, and distribution

In the 2002 survey (see Tables 9, 10) there were four strata with high abundance and biomass estimates, including one stratum located southwest of Burgeo Bank (715, see Fig. 11), one stratum on Burgeo Bank (309), and two strata in Halibut Channel (319, 707). The stratum with the largest catch was 319 located in the Halibut Channel; this stratum accounted for 57.9% of the biomass index and 52.3% of the abundance index for the stock area.

Trends in abundance and biomass from the RV survey of the index strata in 3Ps (depths less than or equal to 300 ftm, excluding the new inshore strata) are shown Fig. 12. The abundance and biomass time series from 1983 to 1999 shows considerable variability, with strong year effects in the data. Both abundance and biomass are low after 1991 with the exception of 1995, 1998, and 2001. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index and therefore has a very large standard deviation. The 1997 Canadian index was the lowest observed in the time series, which goes back to 1983, being less than half of the 1996 index. The size composition of fish in the 1997 RV survey suggested that this survey did not encounter aggregations of older fish, yet these fish were present in the 1996 survey and in commercial and sentinel catches in subsequent years. The minimum trawlable biomass estimate from the 2002 survey was 66,193 t, compared to an estimate of 86,991 t from the 2002 survey. Abundance in 2001 was estimated at 88.2 million versus 61.9 million in 2002.

The survey data are also expressed in terms of catch rates (i.e. mean numbers per tow) for the eastern and western portions of the stock area separately (Fig. 13). The trend for the eastern portion of the stock area is similar to that for the abundance and biomass indices for the stock area as a whole. Catch rates for the eastern portion show considerable variability, with strong year effects, but are generally higher in the 1980's, low after 1991, except in 2001. The 1995 estimate is influenced by a single large catch taken at the bottom of Halibut Channel. The catch rates for the western (Burgeo) portion, which has been surveyed in April since 1993, are extremely variable, but are generally higher than those for the eastern region. The value for 1998 is extremely high due to several large catches on Burgeo Bank and vicinity that may have included fish from the neighbouring northern Gulf cod stock.

Cod appear to have become scarce or absent in shallow strata on St. Pierre Bank in the 1990's (Tables 9 and 10, Fig. 14). Abundance during the early to mid-1990's was highest in the southern Halibut Channel area towards the edge of the survey area, and on the slopes in the vicinity of Burgeo Bank and the Hermitage Channel. However, there is also some indication that cod were becoming more widespread over the survey area during 1997-2000 compared to the early 1990's, albeit at low abundance (Fig. 14). In the April 2001 and 2002 surveys, cod were

less widely distributed across the top of St. Pierre Bank compared to 1999 and 2000 (Tables 9 and 10; Figs. 14 and 15). This change in distribution correlates well with the return to cooler temperatures in 2001 (see below). As in previous years, largest catches in 2002 were localized in the southern Halibut Channel, Fortune Bay, and in the Burgeo Bank-Hermitage Channel area.

An analysis of near-bottom temperatures in 3Ps during winter and spring surveys is presented in Colbourne and Murphy (2002), in relation to the spatial distributions and abundance of cod for the years 1983 to 2002. Inter-annual variations in the near-bottom thermal habitat were examined by calculating the areal extent of the bottom covered with water in 1°C-temperature bins. The analysis revealed a significant shift in the thermal habitat in the region with the areal extent of subzero °C bottom water covering the banks increasing dramatically from the mid-1980s to the mid-1990s. During this time period zero catch rates dominated on St. Pierre Bank and in the eastern regions of 3Ps. Beginning in 1996 the area of 0°C water on the banks decreased significantly reaching very low values in 1998 and a complete disappearance in 1999 and 2000. The areal extent of bottom water with temperatures >1°C on the banks was about 50% of the total area during 1998 the first significant amount since 1984 and it increased further to about 70% during 1999 and to 85% during 2000. During 1999 and 2000 larger catches of cod became more wide spread over St. Pierre Bank region as the cold sub-zero °C water disappeared from the area. There were many zero catches in the eastern areas during 2001 as colder water returned to that region. During all surveys most of the larger catches occurred in the warmer waters (>2-3°C) along the slopes of St. Pierre Bank and areas to the west of St. Pierre Bank. An examination of the cumulative distributions of temperature and catch indicates that cod are associated with the warmer portion of the available temperature distribution, with a slightly warmer preference based on weight than numbers (implying a greater degree of habitat selection by larger fish).

8.2 Age composition

Survey numbers at age are obtained by applying an age-length key to the numbers of fish at length in the samples. The current sampling instructions for Subdiv. 3Ps require that an attempt be made to obtain 2 otoliths per one cm length class from each of the following locations: Northwest St. Pierre Bank (strata 310-314, 705, 713), Burgeo Bank (strata 306-309, 714-716), Green Bank-Halibut Channel (strata 318-319, 325-326, 707-710), Placentia Bay (strata 779-783) and remaining area (strata 315-317, 320-324, 706, 711-712). This is done to spread the sampling over the survey area. The otoliths are then combined into a single age-length key and applied to the survey data. The resulting estimates of mean numbers per tow are given in Table 11. It is in this form that the data are used in the calibration of sequential population analysis models. These data can be transformed into trawlable population at age by multiplying the mean numbers per tow at age by the number of trawlable units in the survey area. This is obtained by dividing the area of the survey by the number of trawlable units. For 3Ps, the survey area is 16,732 square nautical miles including only strata out to 300 fms and excluding the relatively recent strata created in Placentia Bay. The swept area for a standard 15 min tow of the Campelen net is 0.00727 square nautical miles. Thus, the number of trawlable units in the 3Ps survey is 16,732/0.00727=2.3x106.

The mean numbers per tow at age in the research bottom-trawl survey is given in Table 11. The most numerous ages in the 2001 survey were 3 and 4 (1997 and 1998 year-classes). Among older ages, the 1989 year-class is also well represented. However, survey catches over the post-moratorium period have consistently shown few survivors from year-classes prior to 1989. Indications from the 2000 and 2001 surveys are that the 1997 and 1998 year classes are stronger

given that catch rates at ages 3 and 4 are much higher. These age classes were also well distributed across the stock area in the 2001 survey and also appear strong in the GEAC survey and in the sentinel line-trawl catches in 2000. The 1999 year class also appears reasonably strong in the 2001 survey, although data for this year class are still too limited for firm conclusions to be drawn. Overall, the low 1997 survey results appear anomalous given that three year classes (1989, 1990 and 1992) that have been well represented in the post-moratorium fishery, the 1998-2001 DFO surveys, and the fall industry (GEAC) surveys, did not appear to be encountered in the 1997 survey. Although the 1990 and 1989 year classes are still reasonably well represented and have reached ages 11 and 12, respectively, these are among the oldest fish encountered in the survey. The age composition is improving, but remains somewhat contracted relative to the mid-1980's when cod aged 12-20 were consistently encountered in surveys of 3Ps (see Table 11).

The spatial distribution of catches of cod aged 2, 3, 4, and 5 during the 2001 survey was examined (Fig. 16). Age 2's were mostly located in the central portion of the stock area and in shallower water on top of St. Pierre Bank. Age 3 and age 4 cod were widely distributed on Burgeo Bank, St. Pierre Bank, in Fortune Bay, and in Halibut Channel, whereas age 5 cod were mainly located in Fortune Bay, Burgeo Bank, and Halibut Channel.

8.3 Size-at-age (mean length and mean weight)

The sampling protocol for obtaining lengths-at-age (1972-2002) and weights-at-age (1978-2002) has varied over time (Lilly 1998), but has consistently involved stratified sampling by length. For this reason, calculation of mean lengths and weights included weighting observations by population abundance at length (Morgan and Hoenig 1997), where the abundance at length (3-cm size groups) was calculated by areal expansion of the stratified arithmetic mean catch at length per tow (Smith and Somerton 1981).

Mean lengths-at-age (Table 12; Fig. 17) varied over time. A peak occurred in the mid-1970s for young ages (3-4) and progressively later to 1980 for older ages. This peak does not track individual year-classes particularly well, but in general year-classes born in the 1970s experienced faster growth than those born in the 1980s (Lilly 1996; Chen and Mello 1999a). From the mid-1980s to the present, length-at-age tended to increase at young ages (2-3) and to vary with no clear trend at older ages. Year-to-year variability at older ages was considerable (as much as 20 cm at age 10) during the past decade or so.

There has not yet been a thorough analysis to determine if these differences were caused mainly by environmental factors (e.g. temperature or prey availability), cohort factors (e.g. cohort or population abundance, distribution) or any of the numerous additional possibilities, such as changes in maturation schedules (Chen and Mello 1999b) or size-selective fishing mortality. Variability associated with sampling or processing could also be important.

An exploration of the effects of environmental factors such as temperature has not been conducted because there appears to be negative growth for at least 2 cohorts during each of the intervals 1977-1978, 1980-1981, 1989-1990 and 1993-1994 (Lilly 1998). Such extreme year effects could result from the existence within 3Ps of groups of fish with different growth rates, coupled with annual variability in the proportion of the age sample taken from each of those groups. This possibility is discussed further by Lilly (1996), but has not yet been explored.

Much of the high variability in length-at-age at older ages (say 7-10) in recent years appears to be caused by cohort effects. For example, the 1989, 1990 and 1992 year-classes were relatively long at age, whereas the 1988, 1991 and particularly the 1987 year-classes were relatively short (Fig. 18). The small length-at-age of the 1991 year-class, compared to the adjacent 1990 and 1992 year-classes, is striking. There has not yet been an investigation of the reasons for such cohort effects.

Selectivity characteristics of the research trawl are also of concern for accurate estimation of size-at-age at younger ages, particularly ages 1 and 2. It may be assumed that estimation at younger ages has improved since the change to the Campelen trawl in 1996. An important contributor to variability in the estimates of size-at-age at older ages is the increase in range of sizes within a cohort as it ages, combined with a decrease in sample size at length, the latter being a simple consequence of declining abundance.

As expected, the patterns in mean weight-at-age (Table 13; Fig. 19) appear to be very similar to those in length-at-age. The high year-to-year variability at older ages in recent years, noted above for length-at-age, is much more pronounced in weight-at-age, with weights in some years being more than twice that in others. The weight-at-age estimates may include more sampling variability than the length-at-age estimates in years prior to 1990 because they are based on much smaller sample sizes (Lilly 1998). The weight-at-age data also include variability associated with among-year and within-year variability in weight at length (condition).

8.4 Condition

The somatic condition and liver index of each fish were expressed using Fulton's condition factor $((W/L^3)*100)$, where W is gutted weight (kg) or liver weight (kg) and L is length (cm). Condition and liver index at age were calculated as described above for size-at-age.

Mean somatic (gutted) condition at age (Table 14; Fig. 20A) was variable from 1978 to 1986 and relatively constant from 1986 to 1992. It dropped suddenly in 1993, rose to an intermediate level in 1996-1998 and subsequently declined. Condition at age could be influenced by changes in length-at-age (see above) combined with the tendency for condition calculated with Fulton's formula to increase with body length. For this reason, condition at length (Fig. 20B) might be more appropriate than condition at age as an indicator of changes in condition over time. In addition, much of the apparent annual variability in the survey data is related to the timing of the surveys (Lilly 1996). When mean condition in each of three length groups was plotted against the median date of sampling during the survey (Fig. 20C), there was a gradual decline in condition from the earliest median date (Feb. 7) to approximately late April, after which there was an increase. The time course of changes from late April onward is poorly defined because of the paucity of observations. Sampling of cod caught during sentinel surveys in the inshore in 1995 revealed a similar decline in condition during the winter and early spring, with a minimum in roughly late April to early June (Lilly 1996).

Mean liver index at age (Table 15; Fig. 21A) had a pattern similar to that seen in somatic condition, except that the values in 1983 were more clearly at higher levels than during other years in the early 1980s and there was a more pronounced peak in the late 1980s and early 1990s. When the values for specific size groups (Fig. 21B) were plotted against the median date of sampling (Fig. 21C), there was a very pronounced decline in liver index during winter and early spring. A similar decline was evident in samples from the 1995 sentinel survey (Lilly 1996).

From the above, it is clear that the low somatic condition and liver index in recent years (1993-2002) are interpreted to be mainly a consequence of sampling near the low point of the annual cycle and not to be indicative of a large and persistent decline in well-being. Nevertheless, it is also apparent that there was some annual variability within this recent time period. To explore this a little further, percentiles of gutted condition and liver index were calculated for all cod of a relatively wide size range (40-59 cm) sampled during the 1993-2002 period. There was considerable variability in gutted condition (median = 0.692; 90th percentile range = 0.597 – 0.792; n = 1698). The distributions did not vary much among years, but the medians in both 1996 and 1998 were somewhat higher than in other years (Fig. 22). Percentiles for liver index were also highly variable (median = 0.0173; 90th percentile range = 0.0064 – 0.0368; n = 1709). Median liver index was highest in 1998 and lowest in 1999 and 2001. Reasons for these small annual differences have not been investigated, but they will undoubtedly be complex.

8.5 Maturity and spawning

The gonads of samples of cod collected during annual DFO winter/spring bottom-trawl surveys were visually inspected and assigned to the category "immature" or "mature" according to the criteria of Templeman et al. (1978). Mature fish were further classified as maturing, spawning, or spent (see Morgan and Brattey 1996). Visual inspection is not always totally accurate and there can be difficulties in classifying some stages; for example, mature fish that are skipping a spawning year may be erroneously classified as immature or vice-versa, and mature fish that have recently shed a batch of hydrated eggs may be classified as maturing when they are in fact spawning. The extent to which these errors influence the estimation of proportion mature and proportion at each stage of maturation has not been fully evaluated. However, Bolon and Schneider (1999) showed using histological methods that the visual method of classification was reasonably accurate, but tended to slightly underestimate the proportion of spawning fish and overestimate the proportion of maturing fish when spawning was occurring in Placentia Bay.

Annual estimates of age at 50% maturity (A_{50}) for females from the 3Ps cod stock, collected during annual winter/spring DFO RV surveys, were calculated as described by Morgan and Hoenig (1997). As in the 2000 assessment, maturation is estimated by cohort rather than by year; prior to 2000 maturation was estimated by year. In addition, data extending back to 1954 has been included in the current analyses. The estimated age at 50% maturity (A_{50}) was generally between 6.0 and 7.0 from the mid-1950s to the early 1980s, but declined dramatically thereafter to a low of 5.1 during 1988 (Table 16, Fig. 23A). Age at maturity by cohort remained low but fairly constant during 1988 to 1994; estimates for the 1995 and 1996 cohorts are somewhat higher, but estimates for the more recent cohorts are more uncertain because only a small number of younger ages from these cohorts are available to estimate A_{50}. Males show a similar trend over time (data not shown), but tend to mature about one year earlier than females. The annual estimates of proportion mature for ages 3-8 show a similar increasing trend (i.e. increasing proportions of mature fish at young ages) through the late 1970s and 1980s, particularly for ages 5, 6, and 7 (Fig. 23B). The overall age at maturity remains low among 3Ps cod and this has a substantial effect on the estimates of spawner biomass for this stock. In addition, the age composition of the spawning biomass may have important consequences in terms of producing recruits. A spawning stock biomass that consists mainly of older fish, or a broad age range, may result in a longer time span of spawning (Hutchings and Myers 1993; Trippel and Morgan 1994). Older, larger fish also produce more viable eggs and larvae (Solemdal et al. 1995; Kjesbu et al. 1996; Trippel 1998). Several characteristics of the spawning stock biomass (SSB) of 3Ps cod (and other NF fish stocks) were explored for variability and for relationships with the residuals

from Beverton-Holt stock-recruit models (Morgan et al. 2000). Weighted mean age of the SSB, proportion of first time spawners, and proportion female all showed substantial variability over time, but the results were not consistent among the stocks examined and were difficult to interpret.

The time series of maturities for 3Ps cod shows a long-term trend as well as considerable annual variability, but is reasonably stable in the last several years. To project the maturities for 3Ps cod forward to 2010, for each age group the average of the last three estimates for the same age group was used (Table 17). To fill in missing age groups in the early part of the time series the average of the first three estimates for the same age was used. These values were available for projections of mature spawner biomass in the evaluation of TAC options (see Section 9.3).

Maturities of adult female cod sampled in three sub-areas of NAFO subdivision 3Ps during winter/spring RV bottom-trawl surveys from 1983-2002 are shown in Fig. 24. Note that immature fish are excluded from this analysis. The areas are defined as Burgeo Bank / Hermitage Channel (Strata 306-310 and 714-716), Southern 3Ps / Halibut Channel (all areas south of 45°34.5' N), and mid-3Ps which includes the remainder of the subdivision (excluding inshore strata 293-300 and 779-783). The timing of the survey varied through the time series, with surveys predominantly in April during 1983-84, March during 1985-1987, February from 1988-1992, and April from 1993 to 2002. There were two surveys (February and April) in 1993; only the April one is shown here. The three sub-areas show a consistent pattern of maturity stages across most of the time series, with maturing fish dominating in most years. The switch in timing from February to April clearly results in an increase in the proportions of spawning fish and a reduction or disappearance of fish that are spent from the previous year. When surveys were conducted in April, spawning and spent fish were found in each area; within any one year the proportion of spawning and spent fish tended to vary among sub-areas, but generally about 15-40% of the mature fish sampled were spawning or recently spent. The results from the 2002 survey show no dramatic changes from recent years. The results from the March 1987 sample from the Halibut Channel appear somewhat anomalous, with a high proportion of spawning fish compared to other areas in 1987 and compared to adjacent years within the same area. The results also show that a substantial proportion (typically 20-30%) of the mature female cod sampled in the Burgeo area in the April surveys are spawning or spent and therefore, by definition, belong to the 3Ps stock. Most of the remaining adult females are maturing to spawn later in the same year and their stock affinities remain unclear.

Overall, cod in 3Ps appear to spawn over a significant portion of the year and at many locations within the stock area, and there appears to be no consistent peak in the spawning time. Spawning is spatially widespread and is known to occur on Burgeo Bank, St. Pierre Bank, and the Halibut Channel area, as well as inshore in Hermitage Bay (3Psa) Fortune Bay (3Psb) and Placentia Bay (3Psc). Spawning in Placentia Bay in recent years has been studied more intensively (Bolon and Schneider 1999; Lawson and Rose 1999; Bradbury et al. 2000; Mello and Rose 2001).

9. Sequential Population Analysis

9.1 Analyses carried out in the 2001 assessment

In the 2001 assessment, initial diagnostic analyses were carried out to examine quality and coherency of the catch at age and tuning indices prior to running any SPAs. This was followed by a number of sensitivity runs using ADAPT, QLSPA and XSA to examine the effect of

alternative models and formulations. For comparison purposes, the identical model/formulation used for providing scientific advice in the 2000 assessment was also applied to the data (the comparison model). Finally, a set of 5 models/formulations, including the comparison model, were adopted as a basis for presenting a table of risk associated with alternative quota options for 2002/03 fishing season with respect to several biological reference points.

9.2 Description of SPA runs for the current (2002) assessment

In the 2002 assessment, the decision was made to limit analysis to the identical 5 models considered in the 2001 assessment. These models were applied to the catch data from 1977 onwards (except for the comparison run, for which the catch data back to 1959 was used) and included the RV index (split or non-split with respect to the Burgeo Bank strata depending on the model/formulation), Cameron index, Sentinel line-trawl index (and, in the case of the comparison run, the sentinel gillnet index as well) and the GEAC index (with the exception of the comparison run). As was the case in the 2001 assessment (Brattey et al. 2001a) the 5 five model/formulations comprised:

A) QLSPA run with the identical formulation to the "final model" (Run 10) in the 2000 stock assessment (Brattey et al. 2000) and the "comparison run" (Brattey et al. 2001a), updated with an additional year of data for the catch and tuning indices (includes catch from 1959 onwards and the sentinel gillnet index). This run is termed the "comparison run". In this formulation the RV is split into eastern and western portions, self-weighting is applied and the ratio of F at age 14 to the average F on ages 11-13 was estimated, but constrained to be equal in all years between 1959 and 1993. The F ratio was estimated independently for each year between 1998 and 2001, and for ages10-13 in 1993 (each ratio being based on the average of the preceding three ages) on account of the moratorium.
B) QLSPA run with the catch at age from 1977 onwards, same tuning indices as in A (split RV) except with the sentinel gillnet index dropped from the calibration and the Cameron index added, self-weighting of the indices, and the F ratio at age 14 estimated independently for each year from 1977-93 and 1998-2001, but with estimates shrunk towards 0.5 (the fit function is equal to the deviance plus a shrinkage penalty), F ratio in 1993 estimated (with no shrinkage) for ages 10-13 (in each case based on the ratio to the average F in the previous three ages).
C) XSA was run on the same catch at age and tuning indices as B, with survey catchability q on age 14 constrained to be equal to age 13, with F on age 14 constrained to be equal to 0.4*average F on ages 11-13 for 1977-92, and inverse variance weighting of each fleet's estimates of survivors limited to a minimum standard error threshold of 0.5. This limitation is implemented in order to reduce possible influence of fleets with low catchability standard errors at certain ages due to use of too few data points.
D) ADAPT using the same catch and tuning indices as B except the RV index was not split, survivors at age 14 for years 1993-2001 and ages 2-13 in 2001 estimated, F on age 14 constrained to be equal to half average F on ages 11-13 in each year for 1977-1992.
E) ADAPT using the same catch and tuning indices as B, estimated survivors at age 13 for years 1993-2001 and ages 2-12 in 2001, F on age 14 constrained to be equal to half the average F on ages 11-13 in each year for 1977-1992.

Detailed results of the model fit and tables of estimates are only provided for the comparison run (Model A, Figs. 25-30, Table 18). It should be noted that this run is not considered to be "preferred" relative to the other runs. Comparison of results from the 5 SPA formulations are

given in Figs. 31-35 and suggest that there is considerable uncertainty about the absolute size of the 3Ps cod population in terms of spawner biomass (Fig. 31), 3+ biomass (Fig. 34), and 5+ biomass (Fig. 35). However, the trends in the estimates from the 5 models are similar.

The biomass of fish 3 years and older shows a decline from a peak of between 200,000 – 350,000 t in the mid-1980s down to a trough of between 36,000 – 110,000 t in the 1993/1994 period (Fig. 34). This had been followed by a steady increase to levels comparable to those that occurred in about 1988. In contrast to 3+biomass, growth in both the 5+ biomass and spawning stock biomass during the moratorium slowed with the reopening of the fishery in 1997 and biomass leveled off and even declined slightly in the late 1990s early 2000s. The spawner stock biomass estimates for 1 January 2002 ranged from 64,000 to 167,000. Spawner biomass and 5+ biomass are estimated to have decreased during 1999-2001 and to have increased slightly in 2002.

As pointed out in previous assessments there is a worrying overall downward trend in recruitment over the period full time period as shown in the estimates from the "comparison run" which go back to the 1956 yearclass (Fig. 36). This trend is also reflected in the estimates for the 1974 and subsequent year classes from the 5 models/formulations considered in the current assessment (Fig. 32). However, the model estimates suggest that downward trend may have recently been ameliorated by the 1997, and particularly 1998 year classes which appear at this stage to be relatively strong.

Estimates of fishing mortality (on age 8) from the 5 model/formulations (Fig. 33) suggest that there was a general increasing trend throughout the late 1970s, 1980s and early 1990s, a rapid decline as expected coinciding with the moratorium, and an increasing trend following the reopening of the fishery in 1997. Fishing mortality is currently fluctuating around levels comparable to those observed in the 1980s. Fishing mortality expressed in terms of exploitation rate, (proportion of 3+ numbers removed by the fishery) shows similar patterns (Fig. 37). Exploitation during the late 1970s to 1984 was typically between 10 and 15%, but increased rapidly to between 18 and 26% just prior to the moratorium in 1993. With the reopening of the fishery in 1997, exploitation rates were low relative to the pre-moratorium period and increased to above 10% in 1999, but thereafter have declined to below 10% again. However, fish tagged in Placentia Bay have experienced high exploitation rates in recent years (see section on tagging).

9.3 Projections

In the current assessment, 3-year deterministic projections to 1 April 2005 were carried out for TAC options ranging from 10,000 to 20,000 t for the 2003/2004 and 2004/2005 fishing seasons. The inputs for the projections are given in Table 19. These projections indicate that spawner biomass is expected to be higher on April 1, 2005 compared to April 1, 2002 under TAC options of 10, 15 and 20kt (Table 20). Although the percent increase differs among SPA's, this outcome is robust across the 5 models/formulations as well as the range of TAC's considered. Note that the projections were carried out using different computer code for the different models. In some cases the spawner biomass is computed for 1 January and 1 April in each projection year, while in other cases it is not in order to simplify the computer code. Because the fishing season runs from 1 April to 31 March it is most appropriate to compare results from 1 April in one year (e.g. 2005.3) with 1 April in previous years to determine whether the population has growth or not. Because the age composition is incremented only once each year (1 January) and beginning of year weights are applied, spawner biomass will always decrease during the 1 January to 1 April period under the combined effects of natural and fishing mortality.

9. References

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Table 1. Reported landings of cod (t) from NAFO Subdiv. 3Ps, 1959 - 1 Oct 2001 by country and for fixed and mobile gear sectors.

	Can (N)		Can (M)	France			Spain	Portugal	Others	Total	TAC
	Offshore	Inshore		St. P & M		Metro					
Year	(Mobile)	(Fixed)	(All gears)	Inshore	Offshore	(All gears)	(All gears)	(All gears)	(All gears)		
1959	2,726	32,718	4,784	3,078		4,952	7,794	3,647	471	60,170	
1960	1,780	40,059	5,095	3,424	210	2,460	17,223	2,658	4,376	77,285	
1961	2,167	32,506	3,883	3,793	347	11,490	21,015	6,070	5,553	86,824	
1962	1,176	29,888	1,474	2,171	70	4,138	10,289	3,542	2,491	55,239	
1963	1,099	30,447	331	1,112	645	324	10,826	209	6,828	51,821	
1964	2,161	23,897	370	1,002	1,095	2,777	15,216	189	9,880	56,567	
1965	2,459	25,902	1,203	1,863	707	1,781	13,404		4,534	51,853	
1966	5,473	23,785	583	-	3,207	4,607	23,678	519	4,355	66,207	
1967	3,861	26,331	1,259	2,244		3,204	20,851	980	4,044	62,774	
1968	6,538	22,938	585	-	880	1,126	26,868	8	18,613	77,556	
1969	4,269	20,009	849	-	2,477	15	28,141	57	7,982	63,799	
1970	4,650	23,410	2,166	1,307	663	35	35,750	143	8,734	76,858	
1971	8,657	26,651	731	1,196	455	2,730	19,169	81	2,778	62,448	
1972	3,323	19,276	252	990	446	-	18,550	109	1,267	44,213	
1973	3,107	21,349	181	976	189	-	19,952	1,180	5,707	52,641	70,500
1974	3,770	15,999	657	600	348	5,366	14,937	1,246	3,789	46,712	70,000
1975	741	14,332	122	586	189	3,549	12,234	1,350	2,270	35,373	62,400
1976	2,013	20,978	317	722	182	1,501	9,236	177	2,007	37,133	47,500
1977	3,333	23,755	2,171	845	407	1,734	-	-		32,245	32,500
1978	2,082	19,560	700	360	1,614	2,860	-	-	45	27,221	25,000
1979	2,381	23,413	863	495	3,794	2,060	-	-	-	33,006	25,000
1980	2,809	29,427	715	214	1,722	2,681	-	-	-	37,568	28,000
1981	2,696	26,068	2,321	333	3,768	3,706	-	-	-	38,892	30,000
1982	2,639	21,351	2,948	1,009	3,771	2,184	-	-	-	33,902	33,000
1983	2,100	23,915	2,580	843	4,775	4,238	-	-	-	38,451	33,000
1984	895	22,865	1,969	777	6,773	3,671	-	-	-	36,950	33,000
1985	4,529	24,854	3,476	642	9,422	8,444	-	-	-	51,367	41,000
1986	5,218	24,821	1,963	389	13,653	11,939	-	-	7	57,990	41,000
1987	4,133	26,735	2,517	551	15,303	9,965	-	-	-	59,204	41,000
1988	3,662	19,742	2,306	282	10,011	7,373	-	-	4	43,382	41,000
1989	3,098	23,208	2,361	339	9,642	892	-	-	-	39,540	35,400
1990	3,266	20,128	3,082	158	14,929	14,771	-	-	-	41,405	35,400
1991	3,916	21,778	2,106	204	15,789	15,585	-	-	-	43,589	35,400
1992	4,468	19,025	2,238	2	10,164	10,162	-	-	-	35,895	35,400
1993 [1]	1,987	11,878	1,351	-	-	-	-	-	-	15,216	20,000
1994 [1]	82	493	86	-	-	-	-	-	-	661	0
1995 [1]	26	555	60	-	-	-	-	-	-	641	0
1996 [1]	60	707 [2]	118							885	0
1997 [1]	122	7,205 [2]	79	448	1,191					9,045	10,000
1998 [1]	4,320	11,370 [2]	885	609	2,511					19,694	20,000
1999 [1]	3,097	21,231 [2]	614	621	2,548					28,111	30,000
2000 [1]	3,436	16,247 [2]	740	870	3,807					25,100 [4]	
2001 [1]	2,152	11,187	856	639	1,675					16,510 [4]	
2002 [3]	977	7,120	304	21	843					9,264 [4]	

[1] Provisional catches

[2] Includes food fishery and sentinel fishery

[3] Catch for Canada and France to 1 October 2002

[4] TAC's are now set for the period 1 April to 31 March rather than by calender year and the TAC was 20,000 t for 2000-2001 and 15,000 t for 2001-2002 and 2002-2003

Table 2. Reported fixed gear catches of cod (t) from NAFO Subdivision 3Ps by gear type. (Includes non-Canadian catch and recreational fishery catch)

Year		Gillnet	Longline	Handline	Trap	Total
1975		4995	4083	1364	3902	14344
1976		5983	5439	2346	7224	20992
1977		3612	9940	3008	7205	23765
1978		2374	11893	3130	2245	19642
1979		3955	14462	3123	2030	23570
1980		5493	19331	2545	2077	29446
1981		4998	20540	1142	948	27628
1982		6283	13574	1597	1929	23383
1983		6144	12722	2540	3643	25049
1984		7275	9580	2943	3271	23069
1985		7086	10596	1832	5674	25188
1986		8668	11014	1634	4073	25389
1987		9304	11807	1628	4931	27670
1988		6433	10175	1469	2449	20526
1989		5997	10758	1657	5996	24408
1990		6948	8792	2217	3788	21745
1991		6791	10304	1832	4068	22995
1992		5314	10315	1330	3397	20356
1993		3975	3783	1204	3557	12519
1994		90	0	381	0	471
1995		383	182	0	5	570
1996		467	158	137	10	772
1997		3760	1158	1172	1167	7258
1998	[1]	10116	2914	308	92	13430
1999	[1]	17976	3714	503	45	22237
2000	[1]	14218	3100	186	56	17561
2001	[1]	7377	2833	2089	57	12357
2002	[2]	5888	1056	272	118	7335

[1] provisional catch

[2] provisional catch to October 1st 2002

Table 3a. Reported monthly landings (t) of cod from NAFO Subdiv. 3Ps by gear type for 2001 and 2002 (to 1 Oct 2002).

2001	Offshore			Inshore				
MONTH	Otter trawl	Gillnet	Line trawl	Gillnet	Line trawl	Handline	Trap	Total
Jan	720.0	0.0	33.6	859.2	21.8	21.2	0.0	1655.8
Feb	919.1	0.0	132.3	2.1	0.8	0.4	0.0	1054.7
Mar	550.2	49.6	185.6	19.7	0.3	0.0	0.0	805.4
Apr	22.2	0.0	2.4	0.4	0.5	0.0	0.0	25.4
May	55.6	0.0	56.2	3.2	10.8	1.1	0.0	127.0
Jun	0.1	6.0	15.1	780.0	103.8	375.5	11.6	1292.2
Jul	0.6	567.3	70.4	835.5	177.2	840.6	24.8	2516.5
Aug	3.4	309.6	125.7	363.7	224.8	404.1	20.5	1451.9
Sep	34.3	466.0	49.6	307.3	283.2	216.3	0.0	1356.7
Oct	146.2	410.4	8.8	189.1	469.3	100.3	0.0	1324.1
Nov	613.1	175.4	44.2	1483.5	509.4	80.1	0.0	2905.6
Dec	1088.2	73.5	91.9	475.7	215.3	30.4	0.0	1975.1
TOTAL	4152.8	2057.9	815.7	5319.5	2017.3	2070.0	57.0	16490.3

2002	Offshore			Inshore				
MONTH	Otter trawl	Gillnet	Line trawl	Gillnet	Line trawl	Handline	Trap	Total
Jan	451.6	0.0	4.8	239.1	106.5	4.4	0.0	806.5
Feb	387.4	24.5	170.7	104.3	7.8	0.0	0.0	694.7
Mar	959.3	0.0	41.4	67.4	13.5	2.9	0.0	1084.5
Apr	37.2	9.0	12.8	0.1	5.6	0.0	0.0	64.7
May	4.1	0.0	0.8	323.8	26.2	0.4	1.9	357.2
Jun	0.0	12.3	3.2	707.9	122.1	48.7	42.6	936.8
Jul	0.0	56.8	25.2	1879.8	125.5	122.4	21.5	2231.3
Aug	50.7	163.3	41.6	897.8	142.0	72.8	52.4	1420.6
Sep	38.6	56.6	13.9	1349.0	202.3	20.3	0.0	1680.7
Oct	0.0	0.0	0.0	16.6	0.0	0.0	0.0	16.6
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	1929.1	322.6	314.3	5585.9	751.6	271.9	118.3	9293.7

Table 3b. Reported monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during 2001 and 2002 (to 1 Oct 2002).

2001	Inshore			Offshore						
Month	3Psa	3Psb	3Psc	3Psd	3Pse	3Psf	3Psg	3Psh	3Ps_unk	Totals
Jan	0.5	5.4	899.7	1.2	0.0	0.0	3.7	745.2	0.0	1655.8
Feb	1.4	0.9	2.0	8.3	0.0	41.9	7.2	997.6	0.0	1059.3
Mar	5.3	19.8	0.0	64.7	0.1	8.3	32.9	672.4	1.9	805.4
Apr	0.7	0.3	0.1	6.8	1.2	0.0	0.3	15.9	0.0	25.4
May	12.5	5.9	3.2	31.6	32.8	0.0	1.8	39.1	0.0	127.0
Jun	124.4	418.4	728.2	3.2	13.6	0.7	0.1	3.6	0.0	1292.2
Jul	184.0	462.6	1231.5	31.6	8.2	100.6	0.0	17.0	494.3	2529.9
Aug	162.2	355.9	495.4	83.2	46.3	173.3	26.3	71.9	38.8	1453.3
Sep	180.0	290.9	335.9	45.8	32.2	325.3	26.3	118.7	1.5	1356.7
Oct	214.8	185.7	370.9	18.7	112.6	226.2	14.9	18.3	162.0	1324.1
Nov	330.9	379.3	1385.9	26.4	0.0	420.8	2.6	357.3	2.5	2905.6
Dec	54.0	272.5	402.5	21.9	15.1	106.5	4.0	291.5	807.0	1975.1
Totals	1270.8	2397.7	5855.3	343.3	262.1	1403.6	120.2	3348.6	1508.0	16509.7

2002	Inshore			Offshore						
Month	3Psa	3Psb	3Psc	3Psd	3Pse	3Psf	3Psg	3Psh	3Ps_unk	Totals
Jan	18.3	118.7	230.0	56.4	0.0	0.0	0.4	399.6	0.0	823.4
Feb	17.4	25.7	102.6	28.1	4.7	0.0	20.0	482.9	13.2	694.7
Mar	29.7	39.0	24.8	27.3	0.0	4.9	16.2	96.5	843.2	1081.6
Apr	5.9	0.0	0.5	12.8	0.0	13.8	1.7	21.0	9.0	64.7
May	34.5	200.3	117.9	0.4	0.0	0.0	1.9	2.1	0.0	357.2
Jun	92.1	321.6	507.5	6.0	0.4	0.6	1.9	6.7	0.0	936.8
Jul	163.5	476.9	1509.0	21.2	0.5	37.1	0.0	14.5	8.6	2231.3
Aug	165.2	404.2	621.7	11.0	54.2	105.9	1.8	54.2	3.6	1421.8
Sep	196.9	728.9	652.5	25.3	27.5	30.2	2.3	12.1	5.2	1680.7
Oct	0.0	9.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0	16.6
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	723.5	2324.4	3774.2	188.4	87.2	192.5	46.4	1089.6	882.8	9308.9

Table 3c. Reported monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during the management year 1 April 2001 to 31 March 2002.

	Inshore			Offshore						
2001	3Psa	3Psb	3Psc	3Psd	3Pse	3Psf	3Psg	3Psh	3Ps_unk	Totals
Apr	0.7	0.3	0.1	6.8	1.2	0.0	0.3	15.9	0.0	25.4
May	12.5	5.9	3.2	31.6	32.8	0.0	1.8	39.1	0.0	127.0
Jun	124.4	418.4	728.2	3.2	13.6	0.7	0.1	3.6	0.0	1292.2
Jul	184.0	462.6	1231.5	31.6	8.2	100.6	0.0	17.0	494.3	2529.9
Aug	162.2	355.9	495.4	83.2	46.3	173.3	26.3	71.9	38.8	1453.3
Sep	180.0	290.9	335.9	45.8	32.2	325.3	26.3	118.7	1.5	1356.7
Oct	214.8	185.7	370.9	18.7	112.6	226.2	14.9	18.3	162.0	1324.1
Nov	330.9	379.3	1385.9	26.4	0.0	420.8	2.6	357.3	2.5	2905.6
Dec	54.0	272.5	402.5	21.9	15.1	106.5	4.0	291.5		1168.1
2002										
Jan	18.3	118.7	230.0	56.4	0.0	0.0	0.4	399.6	0.0	823.4
Feb	17.4	25.7	102.6	28.1	4.7	0.0	20.0	482.9	13.2	694.7
Mar	29.7	39.0	24.8	27.3	0.0	4.9	16.2	96.5	843.2	1081.6
Totals	1329.0	2555.0	5311.0	380.8	266.7	1358.3	113.0	1912.4	1555.4	14781.9

Table 4A. Numbers of cod sampled (commercial fishery and sentinel survey) for length and age and used to estimate the 3Ps commercial catch-at-age for 2001.

	Number Measured						
	Offshore			Inshore			
Month	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
Jan	3890			5263	835	101	10089
Feb	5320			484	597		6401
Mar	979		365	376	151		1871
Apr	0			47	171		218
May	0			0	51		51
Jun	0	163		5319	1226	1242	7950
Jul	0		339	7201	2885	2706	13131
Aug	0	716		1457	2934	42	5149
Sep	0	576		534	3759	42	4911
Oct	206	608		476	8123		9413
Nov	3292		211	5275	7766	668	17212
Dec	1443			98			1541
Total	15130	2063	915	26530	28498	4801	77937

	Number Aged						
	Offshore			Inshore			
QTR	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
1	662		54	463	227	26	1432
2	72			106	70		248
3	0	187	57	1575	740	330	2889
4	748	8	21	493	1274	51	2595
Total	1482	195	132	2637	2311	407	7164

Table 4b. Numbers of cod sampled (commercial fishery and sentinel survey) for length and age and used to estimate the 3Ps commercial catch-at-age for Jan-Mar 2002.

	Number Measured						
	Offshore			Inshore			
Month	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
Jan	4095			1221	1113		6429
Feb	3467			609	561		4637
Mar	202			683	138		1023
Total	7764	0	0	2513	1812	0	12089

	Number Aged						
	Offshore			Inshore			
QTR	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Total
1	806			71	70		947
2							
3							
4							
Total	806	0	0	71	70	0	947

Table 5a. Estimates of average weight (kg), length (cm), and numbers-at-age (000's) for Canadian landings together with French catch and the resulting total catch numbers-at-age for cod in Nafo Subdiv. 3Ps during 2001.

	Average		Catch (Canadian)			France	Total
	Weight	Length	Number			Nos.	Nos.
AGE	(kg.)	(cm.)	(000'S)	STD ERR.	CV	(000'S)	(000'S)
1	0.00	0.00	0.00	0.00			0.00
2	0.30	32.79	2.01	0.45			2.01
3	0.69	42.73	80.37	3.98	0.05		80.37
4	1.02	48.41	461.88	9.31	0.02	13.16	475.03
5	1.44	54.16	676.04	14.62	0.02	42.39	718.43
6	1.94	59.68	1025.55	20.86	0.02	73.43	1098.98
7	2.57	64.96	1028.41	21.87	0.02	114.56	1142.97
8	3.41	70.75	679.80	17.39	0.03	116.38	796.18
9	3.21	69.82	632.98	17.25	0.03	41.34	674.32
10	3.46	71.34	226.93	10.57	0.05	29.75	256.68
11	5.59	82.57	158.82	6.81	0.04	43.06	201.89
12	8.61	96.45	168.54	4.53	0.03	23.18	191.73
13	7.61	92.52	24.77	1.98	0.08	3.02	27.79
14	8.11	94.71	11.31	1.21	0.11	1.78	13.09
15	8.78	96.38	4.06	0.73	0.18	0.51	4.58
16	9.58	100.04	1.88	0.38	0.20	0.00	1.88
17	16.63	121.00	0.15	0.11	0.70	0.00	0.15
18	6.12	86.24	0.95	0.28		0.00	0.95
19	0.00	0.00	0.00	0.00		0.00	0.00
20	0.00	0.00	0.00	0.00			0.00

Table 5b. Estimates of average weight (kg), length (cm), and numbers-at-age (000's) for Canadian landings together with French catch and the resulting total catch numbers-at-age for cod in NAFO Subdiv. 3Ps during Jan.-Mar. 2002.

	Average		Catch (Canadian)			France	Total
AGE	Weight (kg.)	Length (cm.)	Number (000'S)	STD ERR.	CV	Nos. (000'S)	Nos. (000'S)
1	0.00	0.00	0.00	0.00			0.00
2	0.00	0.00	0.00	0.00			0.00
3	0.74	43.80	0.99	0.51	0.51		0.99
4	0.84	45.47	33.59	2.96	0.09	1.41	34.99
5	1.34	52.92	123.84	5.50	0.04	13.94	137.77
6	1.83	58.35	122.35	7.12	0.06	20.04	142.40
7	2.24	62.25	69.91	6.64	0.09	28.82	98.73
8	3.16	68.93	92.90	6.63	0.07	30.64	123.54
9	4.09	74.90	58.75	5.59	0.10	21.61	80.36
10	3.79	73.70	31.48	3.23	0.10	8.30	39.78
11	4.52	77.09	15.98	2.73	0.17	12.87	28.85
12	8.19	94.92	10.85	1.19	0.11	14.88	25.73
13	9.38	99.16	23.91	1.72	0.07	3.51	27.41
14	7.16	88.96	2.65	0.93	0.35	0.96	3.61
15	12.36	107.91	0.59	0.20	0.33	0.42	1.00
16	13.06	111.67	0.27	0.17	0.61	0.00	0.27
17	0.00	0.00	0.00	0.00		0.00	0.00
18	0.00	0.00	0.00	0.00		0.00	0.00
19	0.00	0.00	0.00	0.00		0.00	0.00
20	0.00	0.00	0.00	0.00			0.00

Table 6. Catch numbers-at-age (000's) for the commercial cod fishery in NAFO Subdiv. 3Ps, all gears combined

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
1959	0	1001	13940	7525	7265	4875	942	1252	1260	631	545	44	1
1960	0	567	5496	23704	6714	3476	3484	1020	827	406	407	283	27
1961	0	450	5586	10357	15960	3616	4680	1849	1376	446	265	560	58
1962	0	1245	6749	9003	4533	5715	1367	791	571	187	140	135	241
1963	0	961	4499	7091	5275	2527	3030	898	292	143	99	107	92
1964	0	1906	5785	5635	5179	2945	1881	1891	652	339	329	54	27
1965	0	2314	9636	5799	3609	3254	2055	1218	1033	327	68	122	36
1966	0	949	13662	13065	4621	5119	1586	1833	1039	517	389	32	22
1967	0	2871	10913	12900	6392	2349	1364	604	316	380	95	149	3
1968	0	1143	12602	13135	5853	3572	1308	549	425	222	111	5	107
1969	0	774	7098	11585	7178	4554	1757	792	717	61	120	67	110
1970	0	756	8114	12916	9763	6374	2456	730	214	178	77	121	14
1971	0	2884	6444	8574	7266	6218	3131	1275	541	85	125	62	57
1972	0	731	4944	4591	3552	4603	2636	833	463	205	117	48	45
1973	0	945	4707	11386	4010	4022	2201	2019	515	172	110	14	29
1974	0	1887	6042	9987	6365	2540	1857	1149	538	249	80	32	17
1975	0	1840	7329	5397	4541	5867	723	1196	105	174	52	6	2
1976	0	4110	12139	7923	2875	1305	495	140	53	17	21	4	3
1977	0	935	9156	8326	3209	920	396	265	117	57	43	31	11
1978	0	502	5146	6096	4006	1753	653	235	178	72	27	17	10
1979	0	135	3072	10321	5066	2353	721	233	84	53	24	13	10
1980	0	368	1625	5054	8156	3379	1254	327	114	56	45	21	25
1981	0	1022	2888	3136	4652	5855	1622	539	175	67	35	18	2
1982	0	130	5092	4430	2348	2861	2939	640	243	83	30	11	7
1983	0	760	2682	9174	4080	1752	1150	1041	244	91	37	18	8
1984	0	203	4521	4538	7018	2221	584	542	338	134	35	8	8
1985	0	152	2639	8031	5144	5242	1480	626	545	353	109	21	6
1986	0	306	5103	10253	11228	4283	2167	650	224	171	143	79	23
1987	0	585	2956	11023	9763	5453	1416	1107	341	149	78	135	50
1988	0	935	4951	4971	6471	5046	1793	630	284	123	75	53	31
1989	0	1071	8995	7842	2863	2549	1112	600	223	141	57	29	26
1990	0	2006	8622	8195	3329	1483	1237	692	350	142	104	47	22
1991	0	812	7981	10028	5907	2164	807	620	428	108	76	50	22
1992	0	1422	4159	8424	6538	2266	656	269	192	187	83	34	41
1993	0	278	3712	2035	3156	1334	401	89	36	52	13	14	5
1994	0	9	76	173	74	62	28	12	3	2	0	0	0
1995	0	3	7	56	119	57	37	7	2	0	0	0	0
1996	0	9	43	43	101	125	35	24	8	2	1	0	0
1997	0	66	427	1130	497	937	826	187	93	31	4	1	0
1998	0	91	373	793	1550	948	1314	1217	225	120	56	15	1
1999	0	49	628	1202	2156	2321	1020	960	873	189	110	21	8
2000	1	76	335	736	1352	1692	1484	610	530	624	92	37	16
2001	2	80	475	718	1099	1143	796	674	257	202	192	28	13
2002*	0	1	35	138	142	99	124	80	40	29	26	27	4

*January-March only

Table 7a. Mean annual weights-at-age (kg) calculated from lengths-at-age based on samples of the catch by commercial fisheries (including food fisheries and sentinel surveys) in Subdivision 3Ps in 1959-2002. The weights-at-age from 1976 are extrapolated back to 1959. The values for 2003 are extrapolations from the 2002 values as described in the text.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1960	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1961	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1962	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1963	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1964	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1965	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1966	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1967	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1968	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1969	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1970	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1971	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1972	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1973	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1974	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1975	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1976	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1977	0.55	0.68	1.30	1.86	2.67	3.42	4.19	4.94	5.92	6.76	6.78	10.90
1978	0.45	0.70	1.08	1.75	2.45	2.99	4.10	5.16	5.17	7.20	7.75	8.72
1979	0.41	0.65	1.01	1.65	2.55	3.68	4.30	6.49	7.00	8.20	9.53	10.84
1980	0.52	0.72	1.13	1.66	2.48	3.60	5.40	6.95	7.29	8.64	9.33	9.58
1981	0.48	0.79	1.32	1.80	2.30	3.27	4.36	5.68	7.41	9.04	8.39	9.56
1982	0.45	0.77	1.17	1.78	2.36	2.88	3.91	5.28	6.18	8.62	8.64	11.41
1983	0.58	0.84	1.33	1.99	2.58	3.26	3.77	5.04	6.56	8.45	10.06	11.82
1984	0.66	1.04	1.40	1.97	2.64	3.77	4.75	5.56	6.01	9.04	11.20	10.40
1985	0.63	0.85	1.23	1.79	2.81	3.44	5.02	6.01	6.11	7.18	9.81	10.48
1986	0.54	0.75	1.18	1.84	2.43	3.15	4.30	5.50	6.19	8.72	8.05	11.91
1987	0.56	0.77	1.21	1.63	2.31	3.02	4.33	5.11	6.20	6.98	7.08	8.34
1988	0.63	0.82	1.09	1.67	2.17	2.92	3.58	4.98	5.61	6.60	7.46	8.92
1989	0.63	0.81	1.16	1.63	2.25	3.37	4.11	5.18	6.29	7.30	7.75	8.73
1990	0.58	0.86	1.27	1.85	2.45	3.00	4.22	5.09	6.35	7.60	8.31	10.37
1991	0.60	0.75	1.17	1.74	2.37	2.91	3.69	4.23	6.34	7.68	8.64	9.72
1992	0.46	0.69	1.04	1.56	2.23	2.89	4.14	5.54	6.42	7.82	10.40	11.88
1993	0.36	0.68	1.08	1.48	2.13	2.82	4.34	4.30	4.68	7.49	6.85	8.24
1994	0.62	0.82	1.30	1.86	2.05	2.75	3.59	4.38	6.29	7.77	6.78	8.07
1995	0.52	0.85	1.57	2.03	2.47	2.78	3.46	4.30	4.27	4.16	5.59	9.24
1996	0.67	0.98	1.48	2.05	2.53	2.94	3.23	4.03	4.82	4.68	7.26	9.92
1997	0.62	0.90	1.30	1.87	2.51	3.24	3.47	3.52	4.59	6.37	8.58	10.73
1998	0.62	1.02	1.57	2.05	2.42	3.10	4.04	4.13	4.62	5.21	6.39	9.69
1999	0.70	0.92	1.57	2.31	2.53	2.82	3.92	5.32	4.99	5.27	6.14	7.27
2000	0.62	0.90	1.36	2.07	2.74	2.81	3.15	4.60	6.54	6.12	6.42	7.73
2001	0.69	1.02	1.44	1.94	2.57	3.41	3.21	3.46	5.59	8.61	7.61	8.11
2002	0.67	1.04	1.62	2.08	2.40	3.06	4.05	3.82	4.29	6.73	9.96	9.10

Table 7b . Beginning of the year weights-at-age calculated from commercial mean annual weights-at-age, as described in Lilly (MS 1998). The values for 2003 are extrapolated as described in the text.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1960	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1961	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1962	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1963	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1964	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1965	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1966	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1967	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1968	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1969	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1970	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1971	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1972	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1973	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1974	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1975	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1976	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1977	0.49	0.44	0.95	1.42	2.12	2.86	3.67	4.50	5.48	6.38	7.84	9.37
1978	0.37	0.62	0.86	1.51	2.13	2.83	3.74	4.65	5.05	6.53	7.24	8.75
1979	0.31	0.54	0.84	1.33	2.11	3.00	3.59	5.16	6.01	6.51	8.28	9.17
1980	0.42	0.54	0.86	1.29	2.02	3.03	4.46	5.47	6.88	7.78	8.75	9.55
1981	0.38	0.64	0.97	1.43	1.95	2.85	3.96	5.54	7.18	8.12	8.51	9.44
1982	0.33	0.61	0.96	1.53	2.06	2.57	3.58	4.80	5.92	7.99	8.84	9.78
1983	0.43	0.61	1.01	1.53	2.14	2.77	3.30	4.44	5.89	7.23	9.31	10.11
1984	0.58	0.78	1.08	1.62	2.29	3.12	3.94	4.58	5.50	7.70	9.73	10.23
1985	0.58	0.75	1.13	1.58	2.35	3.01	4.35	5.34	5.83	6.57	9.42	10.83
1986	0.45	0.69	1.00	1.50	2.09	2.98	3.85	5.25	6.10	7.30	7.60	10.81
1987	0.46	0.64	0.95	1.39	2.06	2.71	3.69	4.69	5.84	6.57	7.86	8.19
1988	0.56	0.68	0.92	1.42	1.88	2.60	3.29	4.64	5.35	6.40	7.22	7.95
1989	0.54	0.71	0.98	1.33	1.94	2.70	3.46	4.31	5.60	6.40	7.15	8.07
1990	0.51	0.74	1.01	1.46	2.00	2.60	3.77	4.57	5.74	6.91	7.79	8.96
1991	0.56	0.66	1.00	1.49	2.09	2.67	3.33	4.22	5.68	6.98	8.10	8.99
1992	0.38	0.65	0.88	1.35	1.97	2.62	3.47	4.52	5.21	7.04	8.94	10.13
1993	0.23	0.56	0.86	1.24	1.82	2.51	3.54	4.22	5.09	6.94	7.32	9.25
1994	0.53	0.54	0.94	1.42	1.74	2.42	3.19	4.36	5.20	6.03	7.13	7.43
1995	0.38	0.72	1.13	1.63	2.14	2.39	3.08	3.93	4.32	5.12	6.59	7.88
1996	0.58	0.72	1.12	1.79	2.26	2.70	3.00	3.73	4.55	4.47	5.49	7.45
1997	0.48	0.78	1.13	1.67	2.27	2.86	3.20	3.37	4.30	5.54	6.34	8.83
1998	0.51	0.79	1.19	1.64	2.13	2.79	3.62	3.79	4.03	4.89	6.38	9.12
1999	0.62	0.76	1.26	1.91	2.28	2.61	3.49	4.64	4.54	4.93	5.65	6.81
2000	0.51	0.79	1.12	1.80	2.52	2.67	2.98	4.25	5.90	5.53	5.82	6.89
2001	0.48	0.75	1.14	1.57	2.19	2.78	2.94	3.31	4.68	7.06	6.57	7.20
2002	0.53	0.70	1.15	1.72	2.01	2.47	3.06	3.36	3.79	5.14	8.12	7.71
2003	0.53	0.78	1.06	1.68	2.23	2.37	2.94	3.67	4.01	4.52	6.01	10.03

Table 8. Standardized gillnet (5.5 in mesh) and line-trawl annual catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gill nets and fish per 1000 hooks for line-trawl.

Gill net Year/Age	3	4	5	6	7	8	9	10	Totals
1995	0.020	0.094	4.309	9.069	5.288	2.547	0.330	0.117	21.774
1996	0.020	0.246	2.356	10.828	8.934	2.567	0.740	0.060	25.750
1997	0.011	0.224	4.985	4.629	7.784	6.968	0.853	0.626	26.082
1998	0.003	0.039	0.808	5.506	2.666	1.950	1.231	0.282	12.485
1999	0.000	0.008	0.811	1.251	1.835	0.637	0.212	0.197	4.952
2000	0.010	0.027	0.256	0.618	0.598	0.797	0.259	0.090	2.654
2001	0.025	0.150	0.347	0.724	0.561	0.294	0.273	0.113	2.487

Linetrawl Year/Age	3	4	5	6	7	8	9	10	Totals
1995	10.431	19.680	63.567	88.263	22.917	17.257	3.252	1.319	226.686
1996	9.402	34.175	32.497	51.945	53.623	14.864	8.349	1.873	206.727
1997	6.809	27.811	27.710	18.406	17.260	24.743	2.292	1.787	126.817
1998	10.469	22.773	26.227	20.669	7.555	11.441	13.599	2.267	115.000
1999	11.007	22.013	26.660	19.812	8.561	6.604	4.647	1.468	100.771
2000	18.436	39.816	37.261	24.211	10.551	9.329	2.888	1.111	143.603
2001	20.045	30.638	21.756	12.216	7.040	4.255	2.456	0.614	99.019

Table 9. Cod abundance estimates (000's of fish) from DFO bottom trawl research vessel surveys in NAFO Division 3Ps. Shaded cells are model estimates. See Fig. 20 for locations of strata. Tel 351

Depth range (fathoms)	Strata	Vessel	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Trips	9	28	26	45	55+56	68	81	91	103	118	133	135	150-151	166-167	186-187	202-203	219-220	236-237	313-315	364-365	418-419
		Sets	164	93	109	136	130	146	146	108	158	137	136	130	196	161	148	158	176	175	171	173	177
		Mean Date	30-Apr	13-Apr	13-Mar	15-Mar	7-Mar	5-Feb	9-Feb	9-Feb	10-Feb	14-Feb	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr-97	21-Apr	24-Apr	21-Apr	18-Apr	15-Apr
		sq. mi.	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
<30	314	974	2527	134	96	0	0	211	30	45	0	0	0	0	74	0	0	77	57	1729	1531	153	57
	320	1320	3424	3473	1089	262	248	363	853	0	620	20	0	0	0	0	545	303	1292	3546	5183	1543	478
31-50	293 [1]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	107	292	601	394	219	131
	308	112	627	801	1741	0	169	247	15	77	31	62	39	308	701	223	177	262	4175	2704	1629	1094	285
	312	272	6086	374	8026	56	318	580	82	0	56	0	37	0	0	87	37	19	100	481	1235	636	112
	315	827	1535	1193	1993	2920	483	190	228	57	439	33	0	0	0	0	1387	38	5721	2429	1895	1040	228
	321	1188	2355	954	210	82	867	238	38	102	535	0	0	20	0	0	345	18	45	884	1161	55	98
	325	944	666	312	0	81	152	43	148	130	1088	455	14	0	0	0	103	108	16	762	2824	1526	65
	326	166	99	0	50	0	69	80	0	34	69	0	46	0	0	154	11	0	11	52	109	57	0
	783	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	47	16	110	65	142	13
51-100	294	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	176	901	362	170	195	613
	297 [1]	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	408	209	1892	7000	450	450
	307	395	1943	350	4347	15450	3586	8803	5524	2717	797	868	353	2826	12759	1087	1645	1123	23480	5879	6891	5695	833
	311	317	7907	1090	14969	3183	16905	17235	1599	2369	1134	218	145	392	2562	116	654	371	1952	2169	2964	610	780
	317	193	8266	27	8190	4898	3487	2695	2383	226	1978	531	0	158	0	485	1195	451	173	305	1467	637	1049
	319	984	16321	4829	338	9526	25403	17258	5888	8144	25784	2883	647	3023	150	575	11477	1889	15600	11839	9327	58696	34398
	322	1587	8936	2694	10297	11946	9140	5030	7760	3745	5758	81	0	0	431	0	594	234	260	713	1529	413	633
	323	696	3606	3879	6930	8866	10627	4040	2134	120	2011	16	0	0	0	0	82	24	32	158	1001	941	54
	324	494	8885	7203	38157	720	1087	2395	0	353	2633	163	0	0	544	85	91	272	160	361	442	85	306
	781	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	307	280	195	276	1058	716	1564	261
	782 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	302	0	nf	63	38	38	315	76	227
101-150	295	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	168	465	876	615	978	144
	298 [1]	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	110	1861	46	3450	670	371
	300 [1]	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	584	1579	641	896	791	746
	306	363	2110	75	574	1971	3845	2422	1265	8273	982	1116	389	2659	1273	350	1106	816	771	708	4191	949	248
	309	298	937	122	2484	4622	2443	3461	1771	5766	3122	244	96	1853	244	421	8190	260	11980	215	142	2056	13172
	310	170	133	94	203	351	304	606	6443	3414	13403	175	82	748	405	385	421	1380	105	131	187	505	465
	313	165	68	23	238	0	409	136	2054	908	6866	2962	11	238	68	1124	182	0	454	91	113	3564	125
	316	189	240	117	78	26	78	87	1586	20669	3081	104		147	182	182	26	65	104	23	13	26	117
	318	129	6	0	974	27	710	18	4924	648	9855	5900	5051	2103	0	95656	630	1881	53	0	231	44	71
	779	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	248	0	0	0	39	0	73	26	29
	780	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	35	18	0	40	0	0
151-200	296	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	632	4	375	107	1924	735
	299 [1]	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	643	49	0	13	131	160
	705	195	9	0	563	791	255	644	94	107	134	161	80	939	528	1113	418	241	376	24	54	83	241
	706	476	13	0	1097	557	9835	851	48	98	49	445	109	327	327	442	393	172	327	87	49	49	87
	707	74	3	0	836	560	753	1019	122	557	2682	1323	1817	494	219	448	2912	353	102	9	0	293	3079
	715	128	158	44	3216	1638	643	3724	167	2509	20768	2386	309	1748	2249	414	4117	516	5874	484	751	3013	1615
	716	539	167	25	371	7656	2768	3470	704	593	1216	3879	463	204	519	578	1764	91	3089	2429	196	99	1333
201-300	708	126	0	0	2119	451	14317	14490	113	1410	537	1300	813	1621	15842	2806	208	388	1464	947	0	35	151
	711	580	20	0	33	8227	392	387	219	544	9095	503	178	0	41	20	77	44	16	0	783	80	49
	712	731	0	117	620	419	67	536	141	1931	1730	716	1088	302	369	322	101	60	201	50	98	117	67
	713	851	33	285	117	117	1453	368	843	20233	6961	1806	2819	234	1405	893	652	901	61	79	178	384	320
	714	1074	43	980	6701	935	396	905	4753	20965	32839	15431	12120	1440	2428	2996	750	2765	485	173	151	3781	1346
301-400	709	147	0	0	0	0	nf	30	10	nf	40	nf	4556	1087	nf	101	0	nf	0	0	10	30	0
401-500	710 [2]	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	32	nf	nf	nf	nf	0	nf	nf	nf
501-600	776	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778	168	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total [3]		77,124	29,213	116,546	86,238	111,219	93,723	51,885	104,745	155,522	43,882	26,713	21,785	43,330	110,985	40,250	15,122	78,250	39,438	46,543	88,209	61,895
	Total [4]		77,124	29,213	116,546	86,238	111,219	93,753	51,895	104,745	155,562	43,882	31,269	22,872	43,912	111,393	40,530	18,290	83,997	45,537	50,428	95,405	65,775
	upper		107,185	53,111	618,003	126,503	169,378	153,906	79,714	177,819	240,690	64,676	48,856	29,586	72,419	1,325,521	64,189	21,365	166,891	55,196	60749	147318	119231
	t-value		2.12	3.18	12.71	2.26	2.45	3.18	3.18	2.78	2.57	2.45	3.18	2.31	2.78	12.71	2.45	2.31	3.182	2.23	2.20	2.36	2.78
	std [5]		14,180	7,515	39,466	17,801	23,767	18,931	8,746	26,299	33,139	8,487	7,273	3,377	10,464	95,558	9,771	2,703	27,857	7,056	6,457	25,046	20,624

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata.

[4] totals are for all strata fished.

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 9. Cod abundance estimates (000's of fish) from DFO bottom-trawl research vessel surveys in NAFO Division 3Ps. Shaded cells are model estimates. See Fig. 20 for locations of strata. Tel 351

Depth range (fathoms)	Strata		Vessel	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
			Trips	9	26	26	45	55+56	68	81	91	103	118	133	135	150-151	166-167	186-187	202-203	219-220	236-237	313-315	364-365	418-419
			Sets	164	93	109	136	130	146	146	108	156	137	136	130	166	161	146	159	176	175	171	173	177
			Mean Date	30-Apr	13-Apr	13-Mar	15-Mar	7-Mar	5-Feb	9-Feb	9-Feb	10-Feb	14-Feb	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr-97	21-Apr	24-Apr	21-Apr	18-Apr	15-Apr
			sq. mi.	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
<30	314		974	2527	134	96	0	0	211	30	45	0	0	0	0	74	0	0	77	57	1729	1531	153	87
	320		1320	3424	3473	1089	282	248	363	853	0	620	20	0	0	0	0	545	303	1292	3546	5183	1543	478
31-50	293	5	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	107	292	801	394	219	131
	308		112	627	901	1741	0	169	247	15	77	31	62	39	308	701	223	177	262	4175	2704	1829	1094	295
	312		272	6086	374	8026	56	318	580	62	0	58	0	37	0	0	87	37	19	100	461	1236	636	112
	315		827	1536	1183	1983	2920	483	190	229	57	439	33	0	0	0	0	1387	39	5721	2429	1895	1040	229
	321		1186	2355	954	210	82	867	238	36	102	535	0	0	20	0	0	345	18	49	894	1161	55	98
	325		944	668	312	0	81	152	43	146	130	1068	455	14	0	0	0	103	108	16	762	2824	1526	85
	326		166	99	0	80	0	69	90	0	34	69	0	46	0	0	194	11	0	11	52	169	57	0
	783	1	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	47	16	110	86	142	13
51-100	294	5	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	176	901	362	170	196	613
	297	5	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	408	209	1892	7000	450	450
	307		395	1943	380	4347	15450	3586	6803	5524	2717	797	869	353	2826	12769	1087	1645	1123	23490	5879	6881	5665	833
	311		317	7907	1090	14988	3193	16905	17236	1599	2389	1134	218	145	392	2592	116	654	371	1052	2169	2864	610	780
	317		193	8266	27	8180	4896	3487	2696	2363	226	1078	531	0	158	0	465	1195	451	173	305	1487	637	1049
	319		984	16321	4826	338	9526	26403	17259	5888	6144	25764	2883	647	3023	150	575	11477	1689	15600	11830	9327	58696	34398
	322		1567	8936	2694	10297	11946	9140	5030	7760	3745	5758	91	0	0	431	0	554	234	260	713	1529	413	633
	323		696	3606	3878	6830	8866	10627	4040	2134	120	2011	16	0	0	0	0	82	24	32	158	1001	941	64
	324		494	8885	7203	38157	720	1087	2395	0	353	2633	163	0	0	544	85	91	272	160	361	442	95	306
	781	1	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	307	280	195	276	1058	716	1564	261
	782	1	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	302	0	nf	63	36	36	315	76	227
101-150	295	5	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	168	465	978	815	979	144
	298	6	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	110	1861	46	3450	670	371
	300	5	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	584	1579	641	898	791	746
	308		363	2110	75	574	1971	3845	2422	1295	6273	982	1116	389	2659	1273	350	1106	816	771	708	4191	949	246
	309		298	937	122	2484	4622	2443	3481	1771	3766	3122	244	95	1853	244	421	8190	260	11980	215	142	2056	13172
	310		170	133	94	203	351	304	808	6443	3414	13423	175	82	748	405	386	421	1380	105	131	187	505	485
	313		165	68	23	238	0	409	136	2054	908	6898	2982	11	238	66	1124	182	0	454	91	113	3564	125
	316		189	240	117	78	26	78	87	1586	20669	3081	104		147	182	182	26	65	104	23	13	26	117
	318		129	6	0	974	27	710	18	4924	648	8855	5900	5051	2103	0	95656	630	1891	53	0	231	44	71
	779	1	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	248	0	0	0	38	0	73	26	29
	780	1	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	35	19	0	40	0	0
151-200	296	5	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	632	4	375	107	1924	735
	299	6	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	643	49	0	13	131	160
	705		186	9	0	563	781	255	644	84	107	134	161	80	939	528	1113	419	241	376	24	54	83	241
	706		478	13	0	1097	557	9835	851	49	98	49	445	109	327	327	442	393	172	327	87	49	49	82
	707		74	3	0	636	560	753	1819	122	557	2682	1323	1817	494	219	448	2912	353	102	9	0	293	3079
	715		128	158	44	3218	1638	643	3724	167	2509	20768	2386	309	1748	2249	414	4117	516	5874	494	751	3013	1615
	716		539	167	25	371	7656	2758	3470	704	593	1216	3679	463	204	519	578	1764	91	3089	2428	196	99	1333
201-300	708		126	0	0	2118	451	14317	14490	113	1410	537	1300	813	1621	15842	2808	208	388	1484	947	0	35	151
	711		583	20	0	33	8227	382	387	218	544	9395	503	176	0	41	20	77	44	16	0	783	60	49
	712		731	0	117	620	419	67	536	141	1931	1730	716	1098	302	366	322	101	60	201	50	98	117	67
	713		851	33	295	117	117	1463	368	843	20233	6951	1806	2819	234	1405	883	662	901	81	78	176	364	320
	714		1074	43	960	6701	836	396	905	4753	20966	32839	15431	12120	1440	2428	2986	750	2765	486	173	151	3781	1346
301-400	709	2	147	0	0	0	0	nf	30	10	nf	40	nf	4556	1087	nf	101	0	nf	0	0	10	30	0
401-500	710	1	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	32	nf	nf	nf	nf	0	nf	nf	nf
501-600	776	1	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777	1	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778	1	166	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total	3		77,124	29,213	116,546	98,238	111,219	93,723	51,985	104,745	155,522	43,882	26,713	21,785	43,330	110,985	40,250	15,122	78,250	38,438	46,543	88,209	61,895
	Total	4		77,124	29,213	116,546	98,238	111,219	93,753	51,595	104,745	155,562	43,882	31,289	22,872	43,912	111,393	40,530	18,290	83,997	45,537	60,428	95,405	65,775
	upper			107,185	53,111	618,003	126,503	169,378	153,606	79,714	177,919	240,690	64,676	49,856	29,586	72,419	1,326,621	64,189	21,365	166,991	55,196	80749	147318	119231
	t-value			2.12	3.18	12.71	2.26	2.45	3.18	3.18	2.78	2.57	2.45	3.18	2.31	2.78	12.71	2.45	2.31	3.182	2.23	2.20	2.36	2.78
	std	6		14,180	7,515	39,466	17,801	23,797	18,931	8,746	26,296	33,139	8,487	7,273	3,377	10,484	95,558	9,771	2,703	27,957	7,066	6,457	25,046	20,624

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata.

[4] totals are for all strata fished.

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 10. Cod biomass estimates (t) from DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps. Shaded cells are model estimates. See Fig. 20 for location of strata.

Tel 351

Depth range (fathoms)	Strata		Vessel Trips Sets Mean Dat sq. mi.	AN 9 164 30-Apr 1983	AN 26 93 13-Apr 1984	WT 26 109 13-Mar 1985	WT 45 136 15-Mar 1986	WT 55+56 130 7-Mar 1987	WT 68 146 5-Feb 1988	WT 81 146 9-Feb 1989	WT 91 108 9-Feb 1990	WT 103 158 10-Feb 1991	WT 118 137 14-Feb 1992	WT 133 136 13-Feb 1993	WT 135 130 11-Apr 1993	WT 150-151 166 15-Apr 1994	WT 166-167 161 16-Apr 1995	WT 186-187 148 22-Apr 1996	WT 202-203 158 12-Apr 1997	WT 219-220 176 21-Apr 1998	WT 236-237 175 24-Apr 1999	WT 313-315 171 21-Apr 2000	WT 364-365 173 18-Apr 2001	WT 418-419 177 15-Apr 2002
<30	314		974	15936	733	59	0	0	104	20	240	0	0	0	0	212	0	0	32	8	595	829	46	5
	320		1320	8914	8700	6971	464	700	2299	1883	0	267	52	0	0	0	0	155	114	7766	6287	6761	601	932
31-50	293	5	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	17	19	27	45	26	9
	306		112	1371	1167	1809	0	27	17	8	18	10	18	8	96	235	41	35	93	1461	1572	1088	184	48
	312		272	1179	1080	3881	110	102	25	14	0	23	0	28	0	0	13	4	13	8	226	640	93	10
	315		827	4143	2686	661	4606	1211	1992	2453	129	614	36	0	0	0	0	869	14	20072	3771	3092	491	822
	321		1189	4121	1941	173	616	410	2201	506	24	146	0	0	37	0	0	8	2	0	1855	4582	2	5
	325		944	671	915	0	69	255	53	36	84	246	42	194	0	0	0	173	10	0	418	1307	340	10
	326		166	487	0	83	0	36	59	0	14	45	0	13	0	0	14	0	0	0	8	478	25	0
	783	1	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	0	0	14	16	6	0
51-100	294	5	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	24	40	19	7	26	47
	297	5	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	39	22	1697	2339	108	36
	307		395	2017	1441	8454	19930	4838	21706	6118	1033	171	126	70	1677	8984	250	633	332	16164	3784	5162	1578	197
	311		317	5706	1711	10086	703	8578	2484	755	265	112	25	15	100	585	35	64	51	189	3342	1661	28	145
	317		193	7095	62	15709	3571	1867	352	496	18	756	73	0	244	0	40	73	62	196	36	259	331	88
	319		984	6983	6999	1861	16211	18530	23773	14172	2702	2436	382	82	507	32	208	12785	287	28144	18019	8121	51570	38958
	322		1567	9141	3904	2587	4571	3226	875	492	347	426	32	0	0	38	0	177	118	13	117	1893	193	32
	323		666	1730	3935	2862	5790	21015	514	562	28	160	41	0	0	0	0	99	15	112	227	643	305	7
	324		494	1790	787	24660	521	384	455	0	36	217	33	0	0	7	18	5	11	9	252	25	7	14
	781	1	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	113	40	22	16	64	49	36	13
	782	1	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	8	0	nf	2	7	1	7	0	27
101-150	295	5	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	24	139	45	61	124	8
	298	5	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	42	2608	148	2632	202	75
	300	5	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	147	802	650	307	153	124
	308		363	2167	448	974	2479	3315	4713	605	2786	149	464	114	1820	950	191	194	312	618	553	5123	543	67
	309		296	1690	292	3306	5739	4513	5255	3154	3062	1166	50	15	2021	359	272	4922	87	9788	320	303	1118	15666
	310		170	283	209	503	604	383	662	812	938	880	40	13	378	374	228	124	206	72	145	330	488	209
	313		165	158	242	481	0	563	155	1390	305	472	280	12	152	43	1279	259	0	481	162	87	18231	122
	316		189	492	262	151	113	144	99	3838	13956	294	43		144	270	42	36	40	138	43	21	63	79
	318		129	25	0	2436	146	1359	196	17756	668	2339	1600	1709	1616	0	129689	1075	404	88	0	592	28	43
	779	1	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	16	0	0	0	10	0	4	1	1
	780	1	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	3	1	0	6	0	0
151-200	296	5	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	175	1	102	20	341	119
	299	5	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	292	231	0	1	411	955
	705		195	55	0	904	1083	273	1053	52	235	16	67	47	1143	652	1927	663	476	345	25	20	71	244
	706		476	72	0	3010	907	15334	1927	189	153	182	436	76	251	277	386	575	379	266	68	63	26	40
	707		74	11	0	1672	2779	1821	9883	411	459	1385	767	914	648	24	591	5408	72	121	21	0	360	3726
	715		126	589	99	6462	2736	1316	7420	345	1061	17037	1928	347	1743	2802	576	3807	233	6849	1127	1240	5599	2525
	716		539	311	24	710	7731	3291	4722	779	1112	386	952	64	226	676	777	1457	44	1772	4106	229	92	554
201-300	708		126	0	0	4446	690	18385	42342	123	1220	1072	2419	368	1081	10036	5511	247	629	4389	1455	0	54	139
	711		583	26	0	62	10625	569	841	745	496	23174	360	290	0	30	27	82	43	11	0	1242	75	35
	712		731	0	410	1257	644	262	1042	207	1419	1523	1020	1305	243	819	372	118	151	267	25	64	65	25
	713		951	61	1023	154	544	2469	567	1096	30722	6295	2025	3263	374	1700	1545	1481	1101	48	143	123	273	235
	714		1074	266	3788	16731	2748	473	1478	7310	30866	32846	18802	12987	1739	2528	4161	824	3471	725	155	123	4113	1212
301-400	709	2	147	0	0	0	0	nf	118	52	nf	27	nf	2457	736	nf	121	0	nf	0	0	5	59	0
401-500	710	1	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	19	nf	nf	nf	nf	0	nf	nf	nf
501-600	776	1	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777	1	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778	1	168	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total	3		77,499	42,838	123,054	98,611	115,746	136,422	68,327	94,388	94,926	32,214	21,934	16,240	31,841	148,191	36,442	8,802	100,100	49,857	46,111	66,991	66,193
	Total	4		77,499	42,838	123,054	98,611	115,746	136,540	68,379	94,388	94,952	32,214	24,391	16,976	31,684	148,425	36,482	9,579	103,998	51,824	51,610	66,484	67,309
	upper			112007	50251	434252	140824	195889	679921	101515	170365	170491	45569	22297	22297	54348	1791842	54585	14193	190874	71,356	60,876	148,519	134,681
	t-value			2.20	2.06	12.71	2.26	2.46	12.71	2.31	2.31	2.57	2.26	2.13	2.31	2.78	12.71	2.23	2.36	2.201	2.13	2.15	2.57	2.78
	std	6		15,678	3,599	24,492	19,608	28,630	42,762	15,260	32,943	29,403	5,909	170	2,622	8,168	129,320	8,143	2,284	27,612	10,563	6,867	23,641	24,636

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 709 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata.

[4] totals are for all strata fished.

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 11. Mean numbers per tow at age in Campelen units for the Canadian RV index for the period 1983 to 2001. Data are adjusted for missing strata. There were two surveys in 1993 (January and April).

Age/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993.1 (Jan)	1993.2 (Apr)	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	6.42	0.30	0.38	0.20	1.09	0.42	0.49	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.90	0.22	0.52	1.24	1.25	0.57	0.58
2	10.01	5.40	7.74	6.62	8.48	9.13	6.50	1.48	27.69	1.80	0.00	0.00	1.63	0.31	1.08	1.53	0.97	2.54	3.33	2.26	1.10
3	6.52	2.33	14.88	5.65	5.67	5.93	4.66	9.82	5.03	6.95	1.83	1.99	1.46	1.16	3.67	2.33	6.79	2.55	5.36	12.41	3.90
4	1.14	1.55	12.57	6.48	4.97	2.96	3.17	14.49	10.00	2.11	4.03	4.04	4.31	1.67	3.62	1.04	8.42	2.38	3.10	12.29	8.28
5	3.72	0.63	9.96	7.95	13.82	2.84	1.51	10.89	11.24	4.15	0.71	1.49	6.10	13.08	1.32	0.50	5.60	2.58	2.17	4.36	5.85
6	1.62	2.11	3.28	6.33	8.31	6.50	1.16	5.67	5.75	2.03	2.96	1.35	1.73	19.65	2.69	0.28	3.99	2.34	1.82	2.04	3.04
7	0.48	0.77	2.66	2.13	3.35	5.84	2.15	3.84	2.84	1.03	0.68	0.47	1.62	4.40	2.91	0.30	1.96	1.72	1.20	1.26	2.04
8	0.89	0.37	0.79	1.47	1.29	3.65	1.21	3.14	1.58	0.53	0.33	0.10	0.50	5.75	0.54	0.24	2.50	0.44	0.89	0.77	0.99
9	1.61	0.46	0.48	0.84	0.69	1.49	0.67	1.15	1.19	0.26	0.13	0.04	0.08	2.19	0.46	0.14	2.79	0.79	0.35	0.71	0.53
10	0.75	0.71	0.42	0.29	0.28	0.84	0.37	0.71	0.74	0.24	0.09	0.03	0.04	0.25	0.09	0.05	0.43	0.60	0.31	0.38	0.37
11	0.36	0.18	0.42	0.24	0.23	0.74	0.41	0.32	0.56	0.08	0.11	0.04	0.03	0.20	0.09	0.02	0.30	0.09	0.53	0.50	0.08
12	0.14	0.15	0.49	0.29	0.16	0.35	0.13	0.16	0.22	0.04	0.03	0.01	0.02	0.01	0.02	0.00	0.06	0.02	0.12	0.94	0.12
13	0.06	0.06	0.21	0.17	0.17	0.16	0.11	0.12	0.11	0.01	0.04	0.00	0.01	0.07	0.00	0.00	0.03	0.02	0.00	0.12	0.19
14	0.05	0.03	0.12	0.10	0.16	0.15	0.05	0.09	0.07	0.01	0.01	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.06	0.01
15	0.04	0.00	0.03	0.06	0.06	0.09	0.09	0.01	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
16	0.04	0.04	0.03	0.04	0.04	0.10	0.06	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
17	0.01	0.00	0.05	0.02	0.05	0.01	0.04	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.02	0.03	0.02	0.00	0.04	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.01	0.01	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 12. Mean length-at-age (cm) of cod sampled during research bottom-trawl surveys in Subdivision 3Ps in winter-spring 1972-2002. Entries in boxes are based on fewer than 5 aged fish. Some entries are different from those in Table 6 of Lilly (MS 1996) because only data from successful sets in the index strata are included in the present analyses.

Age	1972	1973	1974	1975	1976	1977
1	14.0	11.6	12.2	12.7	13.2	11.0
2	23.2	22.6	21.7	23.1	22.8	20.3
3	31.5	31.7	33.4	35.3	35.4	31.7
4	41.0	39.3	43.1	44.4	48.2	43.2
5	51.9	50.1	50.8	55.4	57.4	55.6
6	58.5	56.6	55.6	61.0	64.6	63.5
7	63.0	62.1	63.6	66.5	68.1	73.9
8	74.1	66.1	71.2	74.3	71.6	75.2
9	81.8	68.4	69.3	74.2	78.5	88.0
10	90.4	81.1	79.0	75.2	81.6	83.8
11	95.0	88.2	93.3	76.2	94.8	77.6
12	88.3	87.1	95.6	107.2	110.5	87.9

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1		10.8	14.6	14.6	13.2	10.3	12.0		11.0	10.7	9.2	12.0		9.5				
2	19.6	22.1	21.0	22.4	22.0	20.2	19.2	17.9	18.7	19.9	19.7	19.2	20.0	19.2	20.7		19.1	21.2
3	28.0	32.2	28.1	32.4	33.3	31.2	30.6	29.0	26.8	29.5	29.0	30.1	29.9	29.5	30.5	30.9	32.3	30.1
4	35.9	42.6	42.9	44.4	44.9	43.0	42.1	40.3	40.3	39.4	40.8	41.6	40.0	38.5	40.9	41.1	39.2	41.4
5	48.0	47.4	50.6	50.6	53.4	52.6	51.8	50.9	48.6	48.1	47.5	47.9	48.0	46.9	47.1	48.0	48.0	50.3
6	59.0	56.3	58.2	58.6	59.3	57.8	60.6	60.0	55.5	53.9	56.2	56.0	53.7	53.3	55.1	52.6	50.2	56.4
7	65.6	70.5	71.3	63.2	66.4	65.4	66.2	66.3	62.1	61.1	61.9	63.9	56.6	57.4	61.1	62.2	53.6	58.2
8	70.1	76.8	84.8	69.9	70.1	71.4	70.6	74.0	72.1	67.3	66.7	71.8	62.2	62.7	62.4	70.3	59.1	57.9
9	84.1	85.8	94.9	72.6	75.6	73.3	75.6	74.3	76.4	77.8	74.6	75.9	70.1	68.1	66.6	77.1	68.0	63.0
10	86.3	95.3	98.0	83.2	90.6	79.4	78.9	79.3	82.6	85.4	79.7	84.4	76.1	73.7	73.4	80.5	88.0	79.8
11	88.3	94.3	97.2	97.6	98.7	89.6	84.1	89.1	93.3	83.1	79.7	88.5	79.4	73.8	83.6	96.0	79.3	81.2
12	79.3	116.0	106.6	90.1	104.6	94.1	98.2	93.0	93.8	89.9	87.5	96.5	88.7	77.2	81.8	106.0	90.3	83.6

Age	1996	1997	1998	1999	2000	2001	2002
1	12.6	12.7	10.6	12.0	13.3	10.6	12.0
2	20.6	24.1	22.3	22.2	22.0	21.9	22.0
3	30.0	31.7	32.5	31.4	31.7	33.3	31.7
4	38.6	40.8	42.5	42.9	40.7	40.7	42.1
5	44.0	47.9	48.7	51.2	48.6	47.3	50.5
6	52.9	51.5	53.2	58.9	54.6	51.8	54.9
7	60.9	60.6	57.5	61.7	60.3	57.3	55.2
8	61.1	65.2	67.0	66.2	65.3	68.4	67.2
9	63.3	66.9	77.2	77.6	67.8	78.2	74.5
10	76.7	67.3	77.2	86.5	81.1	75.8	79.7
11	74.7	82.5	64.3	76.9	92.5	89.0	73.4
12	86.1		78.0	109.0	89.1	96.2	86.0

Table 13. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1978-2002. Entries in boxes are based on fewer than 5 aged fish.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1		0.011	0.027		0.040	0.010								0.012				
2	0.057	0.070	0.068	0.060	0.103	0.068	0.073		0.045		0.057	0.060	0.062	0.054	0.064		0.053	0.062
3	0.177	0.258	0.147	0.265	0.420	0.232	0.268	0.214	0.168	0.248	0.193	0.239	0.208	0.217	0.230	0.220	0.254	0.212
4	0.396	0.633	0.618	0.704	0.829	0.718	0.632	0.505	0.462	0.538	0.582	0.613	0.538	0.465	0.574	0.550	0.460	0.540
5	0.979	0.879	1.005	1.079	1.299	1.301	1.212	1.039	0.905	0.950	0.915	0.901	0.954	0.865	0.865	0.894	0.898	1.017
6	1.735	1.565	1.634	1.673	1.539	1.652	1.853	1.566	1.332	1.273	1.494	1.331	1.348	1.324	1.461	1.150	1.044	1.514
7	2.368	3.029	3.457	2.081	2.555	1.861	2.790	2.279	2.384	1.885	2.214	2.361	1.621	1.702	2.032	1.987	1.236	1.687
8	3.192	5.666	5.791	3.496	2.612	3.555	3.828	3.206	3.337	2.297	2.423	3.778	2.185	2.346	2.258	3.003	1.814	1.585
9	4.676	5.798	8.459	4.890	4.007	4.042	4.225	3.143	5.023	4.483	3.943	4.505	3.060	3.087	2.859	4.281	2.891	2.209
10	5.711	7.108	8.333	7.591	6.441	4.896	5.029	3.760	4.654	6.344	4.839	5.820	4.225	3.956	3.983	4.470	6.450	4.767
11	4.901	9.030	9.085	8.374	8.885	8.848	7.866		6.633	6.616	4.262	8.285	4.934	4.050	5.796	8.673	4.470	5.446
12	5.760		10.158	11.463	13.068	10.270	9.818	3.970	8.867	5.945	9.103	9.061	7.365	4.906	5.240	13.200	6.748	5.544

Age	1996	1997	1998	1999	2000	2001	2002
1	0.018	0.016	0.011	0.014	0.018	0.012	0.015
2	0.072	0.108	0.091	0.095	0.087	0.086	0.087
3	0.218	0.257	0.282	0.286	0.272	0.293	0.258
4	0.461	0.552	0.659	0.646	0.562	0.545	0.595
5	0.673	0.878	0.941	1.130	0.953	0.819	1.031
6	1.283	1.076	1.274	1.709	1.333	1.204	1.367
7	2.009	1.904	1.640	1.992	1.902	1.668	1.357
8	2.084	2.608	2.791	2.549	2.376	2.999	2.839
9	2.136	2.867	4.660	4.565	2.904	4.453	4.027
10	4.464	3.083	4.441	6.567	5.437	4.402	4.844
11	3.897	5.456	2.528	4.265	8.351	6.949	3.576
12	6.793		4.190	12.388	6.780	8.805	6.031

Table 14. Mean gutted condition-at-age of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in winter-spring 1978-2002. Boxed entries are based on fewer than 5 aged fish. Values for 2001 have been corrected from Brattey et al. (2001).

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1																		
2	0.702	0.629	0.595	0.599	0.660	0.632	0.651		0.699		0.644	0.681	0.623	0.641	0.598		0.627	0.630
3	0.745	0.678	0.620	0.718	0.731	0.742	0.734	0.706	0.698	0.736	0.713	0.725	0.680	0.706	0.711	0.657	0.675	0.687
4	0.733	0.715	0.680	0.748	0.740	0.777	0.735	0.704	0.704	0.725	0.739	0.739	0.726	0.710	0.732	0.711	0.677	0.690
5	0.753	0.702	0.703	0.724	0.722	0.766	0.703	0.680	0.733	0.735	0.731	0.734	0.744	0.720	0.716	0.700	0.705	0.702
6	0.730	0.712	0.709	0.745	0.676	0.794	0.711	0.714	0.709	0.717	0.731	0.741	0.743	0.746	0.733	0.663	0.680	0.708
7	0.744	0.699	0.724	0.729	0.699	0.737	0.728	0.739	0.721	0.735	0.736	0.748	0.735	0.741	0.735	0.677	0.660	0.703
8	0.716	0.775	0.734	0.763	0.690	0.725	0.726	0.714	0.717	0.720	0.736	0.780	0.726	0.738	0.727	0.698	0.676	0.665
9	0.737	0.749	0.765	0.748	0.731	0.744	0.730	0.733	0.676	0.768	0.777	0.793	0.735	0.753	0.738	0.758	0.687	0.701
10	0.793	0.803	0.715	0.810	0.751	0.793	0.741	0.740	0.719	0.770	0.789	0.834	0.764	0.777	0.732	0.684	0.732	0.725
11	0.681	0.648	0.784	0.790	0.758	0.819	0.808		0.798	0.779	0.783	0.827	0.794	0.765	0.766	0.786	0.691	0.750
12	0.725		0.759	0.843	0.833	0.865	0.834	0.681	0.789	0.774	0.813	0.852	0.793	0.794	0.744	0.852	0.717	0.753

Age	1996	1997	1998	1999	2000	2001	2002
1	0.754	0.727	0.898	0.673	0.594	0.963	0.638
2	0.697	0.674	0.660	0.675	0.666	0.665	0.680
3	0.706	0.717	0.699	0.704	0.696	0.684	0.694
4	0.709	0.725	0.720	0.697	0.707	0.686	0.688
5	0.695	0.702	0.704	0.694	0.688	0.680	0.676
6	0.713	0.683	0.680	0.688	0.677	0.722	0.690
7	0.715	0.693	0.689	0.690	0.674	0.659	0.666
8	0.722	0.714	0.725	0.686	0.674	0.699	0.712
9	0.671	0.713	0.757	0.722	0.698	0.702	0.728
10	0.758	0.751	0.742	0.762	0.754	0.695	0.740
11	0.725	0.785	0.748	0.722	0.784	0.732	0.669
12	0.760		0.784	0.737	0.712	0.773	0.734

Table 15. Mean liver index at age of cod caught during bottom-trawl surveys in subdivision 3Ps.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1															
2	0.0175	0.0142	0.0150	0.0118	0.0229	0.0247	0.0120	0.0236	0.0230	0.0304	0.0250	0.0279	0.0292	0.0250	0.0301
3	0.0223	0.0160	0.0114	0.0146	0.0244	0.0280	0.0167	0.0168	0.0233	0.0233	0.0227	0.0216	0.0213	0.0213	0.0200
4	0.0203	0.0181	0.0143	0.0188	0.0228	0.0323	0.0179	0.0175	0.0196	0.0225	0.0275	0.0266	0.0293	0.0280	0.0242
5	0.0227	0.0194	0.0189	0.0169	0.0230	0.0275	0.0142	0.0176	0.0214	0.0240	0.0281	0.0269	0.0335	0.0287	0.0315
6	0.0253	0.0218	0.0204	0.0194	0.0163	0.0348	0.0144	0.0217	0.0230	0.0241	0.0280	0.0300	0.0357	0.0309	0.0309
7	0.0256	0.0293	0.0262	0.0213	0.0207	0.0277	0.0195	0.0217	0.0237	0.0273	0.0279	0.0303	0.0376	0.0362	0.0263
8	0.0323	0.0359	0.0370	0.0322	0.0203	0.0303	0.0191	0.0233	0.0268	0.0291	0.0312	0.0341	0.0334	0.0337	0.0368
9	0.0284	0.0319	0.0381	0.0418	0.0225	0.0326	0.0188	0.0268	0.0303	0.0362	0.0357	0.0412	0.0349	0.0386	0.0400
10	0.0326	0.0362	0.0328	0.0470	0.0258	0.0327	0.0328	0.0301	0.0383	0.0462	0.0439	0.0432	0.0411	0.0410	0.0379
11	0.0256	0.0276	0.0381	0.0277	0.0356	0.0445	0.0330	0.0405	0.0435	0.0404	0.0496	0.0519	0.0471	0.0419	0.0473
12	0.0379		0.0385	0.0415	0.0539	0.0462	0.0451	0.0435	0.0463	0.0482	0.0545	0.0689	0.0477	0.0373	0.0376

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1										
2		0.0304	0.0139	0.0252	0.0244	0.0247	0.0239	0.0241	0.0231	0.0235
3	0.0106	0.0144	0.0111	0.0160	0.0208	0.0165	0.0205	0.0181	0.0150	0.0193
4	0.0154	0.0138	0.0131	0.0161	0.0199	0.0206	0.0170	0.0152	0.0163	0.0155
5	0.0180	0.0197	0.0209	0.0168	0.0201	0.0216	0.0167	0.0193	0.0158	0.0176
6	0.0187	0.0221	0.0201	0.0201	0.0183	0.0249	0.0168	0.0191	0.0209	0.0203
7	0.0184	0.0170	0.0211	0.0219	0.0230	0.0227	0.0210	0.0210	0.0181	0.0172
8	0.0206	0.0211	0.0179	0.0231	0.0240	0.0346	0.0197	0.0222	0.0245	0.0198
9	0.0280	0.0208	0.0189	0.0194	0.0273	0.0407	0.0294	0.0235	0.0270	0.0242
10	0.0182	0.0423	0.0265	0.0303	0.0379	0.0424	0.0388	0.0342	0.0258	0.0271
11	0.0346	0.0232	0.0343	0.0314	0.0396	0.0271	0.0234	0.0385	0.0294	0.0110
12	0.0379	0.0326	0.0247	0.0202		0.0284	0.0260	0.0298	0.0363	0.0259

Table 16. Observed proportion mature at age (only ages 1-12 shown) by cohort (1954-2000) for female Atlantic cod (*Gadus morhua*) from NAFO Subdiv. 3Ps. Parameter estimates of the probit model are also shown: A50=median age at maturity (years); L95% and U95%=lower and upper 95% confidence intervals. SE=standard error, Int=intercept, N=number of fish aged, dot=no fish sampled, nf=no model fit.

Age	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
1	.	.	.	.	.	0.0000	.	0.0000	0.0000	0.0000	0.0000	.	0.0000	.	.
2	.	.	.	.	0.0000	.	0.0000	0.0000	0.0000	0.0000	.	0.0000	0.0000	0.0000	.
3	.	.	.	0.0000	.	0.0000	0.0000	0.0000	0.0000	.	0.0000	0.0000	0.0000	.	0.0000
4	.	.	0.0000	.	0.0000	0.0175	0.0000	0.0152	.	0.0000	0.0000	0.0000	.	0.0999	0.0793
5	.	0.0385	.	0.0588	0.0278	0.0625	0.1482	.	0.1429	0.0000	0.0513	.	0.4291	0.5760	0.4399
6	0.1818	.	0.2667	0.1875	0.0526	0.4167	.	0.4615	0.5000	0.5574	.	0.6403	0.6788	1.0000	0.8683
7	.	0.8125	0.4386	0.3333	0.7143	.	0.7692	1.0000	0.7917	.	0.9239	0.9303	1.0000	1.0000	0.9482
8	1.0000	0.8000	0.6667	1.0000	.	1.0000	0.7500	0.9167	.	1.0000	1.0000	1.0000	0.8306	0.7968	1.0000
9	0.8387	1.0000	1.0000	.	1.0000	1.0000	1.0000	.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	.	1.0000	1.0000	1.0000	.	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	.	1.0000	.	.	.	1.0000	1.0000	.	1.0000	1.0000	1.0000	1.0000	.	1.0000
12	.	1.0000	.	1.0000	.	.	1.0000	1.0000	.	1.0000	1.0000	1.0000	1.0000	.	1.0000
A50	7.36	6.82	7.18	7.07	6.88	6.17	6.37	6.15	6.13	nf	6.60	6.79	6.49	5.98	6.15
L95%	6.02	6.41	6.83	6.68	6.51	5.75	5.90	5.79	5.76	nf	6.20	6.38	6.16	5.53	5.90
U95%	8.09	7.16	7.70	7.96	7.68	7.07	7.03	6.66	6.59	nf	7.04	7.03	6.81	6.46	6.41
Slope	1.11	1.51	1.32	1.46	2.39	2.11	1.67	1.86	1.71	nf	1.93	2.42	1.55	1.69	2.14
SE	0.29	0.22	0.32	0.37	0.59	0.54	0.30	0.36	0.29	nf	0.24	0.60	0.24	0.38	0.29
Int	-8.17	-10.26	-9.46	-10.32	-16.45	-13.02	-10.67	-11.47	-10.51	nf	-12.72	-16.42	-10.06	-10.08	-13.16
SE	2.44	1.61	2.22	2.35	3.62	2.94	1.76	2.07	1.70	nf	1.57	4.24	1.60	2.25	1.79
N	58	143	134	133	230	161	176	245	233	235	316	292	383	139	215

Age	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.	.	0.0000	.	0.0000	0.0000	0.0000	.	.	.	0.0000	0.0000	0.0000	0.0000	0.0000
2	.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0146	0.0145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0950	0.0000	0.0000	0.0000	0.0000
5	0.0781	0.1978	0.3348	0.2542	0.1095	0.0639	0.0993	0.0970	0.0278	0.1450	0.4093	0.0528	0.0264	0.0379	0.0161
6	0.5402	0.7052	0.4700	0.3296	0.3352	0.2117	0.4854	0.4401	0.5312	0.5867	0.3410	0.3495	0.2503	0.1662	0.4927
7	0.6892	0.9610	0.7704	0.6077	0.8661	0.7183	0.6866	0.9129	0.8488	0.8027	0.7137	0.6027	0.4023	0.7909	0.8001
8	0.8884	0.9296	0.9237	1.0000	0.9232	0.9340	1.0000	0.9121	1.0000	0.9565	0.8618	0.8531	0.9322	0.8208	0.8838
9	1.0000	0.8531	1.0000	1.0000	0.9624	1.0000	1.0000	1.0000	1.0000	1.0000	0.8979	0.9653	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	0.9380	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9430	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
A50	6.16	5.80	5.98	6.31	6.44	6.56	6.26	6.35	6.13	5.99	6.26	6.60	6.88	6.62	6.28
L95%	5.86	5.51	5.73	6.07	6.19	6.38	6.02	5.97	5.91	5.81	5.92	6.42	6.69	6.44	6.04
U95%	6.51	6.13	6.23	6.57	6.73	6.75	6.49	6.80	6.35	6.17	6.57	6.79	7.09	6.81	6.55
Slope	1.68	1.53	1.31	1.41	1.45	2.00	1.78	1.36	2.51	1.79	1.03	1.43	1.74	2.01	1.89
SE	0.30	0.23	0.14	0.14	0.17	0.20	0.22	0.21	0.35	0.17	0.11	0.14	0.18	0.21	0.26
Int	-10.37	-8.86	-7.84	-8.91	-9.36	-13.15	-11.16	-8.60	-15.36	-10.73	-6.45	-9.41	-11.99	-13.31	-11.89
SE	1.84	1.31	0.83	0.89	1.03	1.29	1.38	1.25	2.17	1.02	0.77	0.91	1.18	1.35	1.60
N	164	204	351	423	415	601	331	230	376	597	331	551	454	455	271

cont'd:

Table 16. Cont'd.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	.	.	.	.	0.0000	.	0.0000					0	0	0	0
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0	0	0	0	0	0	0
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	0	0	0	0	0	0	0
4	0.0000	0.0000	0.0515	0.0000	0.0685	0.0000	0.0000	0	0.01337	0.23471	0.16744	0.04456	0.11474	0.13916	0.0909
5	0.0767	0.1096	0.1806	0.3493	0.4646	0.0192	0.1097	0.38592	0.73132	0.36244	0.47073	0.63337	0.28566	0.5396	
6	0.6213	0.4797	0.8676	0.9283	0.3469	0.4987	0.5164	0.89429	1	0.78855	0.80563	0.48724	0.7192		
7	0.8402	0.9717	0.9352	0.9034	0.9604	0.7855	0.7440	1	0.96944	0.9492	0.87578	0.9323			
8	1.0000	1.0000	1.0000	0.9430	0.9671	0.9207	1.0000	1	0.95617	1	0.9427				
9	1.0000	1.0000	1.0000	0.9622	1.0000	1.0000	1.0000	1	1	1					
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1	1						
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1							
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.	.	.	.	.	.	.	.
A50	6.01	5.94	5.45	5.29	5.06	5.19	5.15	5.17	5.26	5.26	5.17	5.70	5.42	nf	nf
L95%	5.78	5.76	5.28	5.12	4.84	5.07	4.96	4.94	4.82	4.95	4.89	5.30	4.96	nf	nf
U95%	6.25	6.13	5.62	5.45	5.24	5.32	5.35	5.56	5.41	5.54	5.47	6.26	7.06	nf	nf
Slope	2.23	2.70	2.58	2.25	2.77	1.88	1.79	3.55	2.33	1.81	1.55	1.40	1.87	nf	nf
SE	0.30	0.37	0.29	0.22	0.41	0.16	0.19	1.04	0.36	0.25	0.23	0.27	0.62	nf	nf
Int	-13.42	-16.03	-14.07	-11.92	-14.02	-9.78	-9.20	-18.35	-11.88	-9.53	-8.02	-7.98	-10.15	nf	nf
SE	1.80	2.20	1.59	1.24	2.17	0.81	0.96	5.23	1.77	1.36	1.21	1.44	2.91	nf	nf
N	281	324	417	443	249	745	387	154	195	204	184	153	109	115	71

Age	1999	2000	2001
1	0.0000	0.0000	0.0000
2	0.0000	0.0000	
3	0.0000	.	
4	.	.	
5	.	.	
6	.	.	
7	.	.	
8	.	.	
9	.	.	
10	.	.	
11	.	.	
12	.	.	
A50	nf	nf	
L95%	nf	nf	
U95%	nf	nf	
Slope	nf	nf	
SE	nf	nf	
Int	nf	nf	
SE	nf	nf	
N	45	4	

Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1959 to 2002 projected forward to 2010. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age (see Table 16). Shaded cells are averages of the first or last three estimates for the same age group; boxed cells are the average of adjacent estimates for the same age group.

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1959	0.0006	0.0040	0.0142	0.0677	0.1939	0.4701	0.7574	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1960	0.0000	0.0026	0.0149	0.0610	0.1804	0.4701	0.7574	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1961	0.0002	0.0001	0.0112	0.0536	0.2266	0.4003	0.7574	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1962	0.0007	0.0012	0.0010	0.0464	0.1744	0.5691	0.6693	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1963	0.0004	0.0035	0.0102	0.0111	0.1733	0.4410	0.8562	0.8599	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1964	0.0008	0.0028	0.0185	0.0785	0.1096	0.4745	0.7465	0.9641	0.9490	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1965	0.0005	0.0046	0.0177	0.0914	0.4130	0.5741	0.7955	0.9166	0.9918	0.9826	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1966	0.0001	0.0028	0.0252	0.1041	0.3491	0.8532	0.9365	0.9437	0.9762	0.9982	0.9942	0.9992	0.9997	1.0000	1.0000	1.0000
1967	0.0000	0.0010	0.0159	0.1255	0.4283	0.7410	0.9796	0.9938	0.9863	0.9935	0.9996	0.9981	0.9997	1.0000	1.0000	1.0000
1968	0.0009	0.0001	0.0066	0.0847	0.4435	0.8285	0.9385	0.9975	0.9994	0.9968	0.9983	0.9999	0.9994	1.0000	1.0000	1.0000
1969	0.0012	0.0044	0.0012	0.0438	0.3415	0.8157	0.9689	0.9879	0.9997	0.9999	0.9993	0.9995	1.0000	1.0000	1.0000	1.0000
1970	0.0001	0.0066	0.0205	0.0130	0.2395	0.7498	0.9609	0.9950	0.9977	1.0000	1.0000	0.9998	0.9999	1.0000	1.0000	1.0000
1971	0.0009	0.0012	0.0344	0.0899	0.1292	0.6839	0.9489	0.9927	0.9992	0.9996	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1972	0.0030	0.0049	0.0099	0.1616	0.3174	0.6250	0.9370	0.9915	0.9987	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1973	0.0054	0.0137	0.0257	0.0784	0.5103	0.6864	0.9493	0.9903	0.9986	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1974	0.0023	0.0198	0.0601	0.1241	0.4196	0.8493	0.9115	0.9953	0.9986	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1975	0.0016	0.0093	0.0697	0.2273	0.4324	0.8600	0.9682	0.9798	0.9996	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1976	0.0001	0.0067	0.0369	0.2176	0.5752	0.8038	0.9812	0.9940	0.9956	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1977	0.0005	0.0008	0.0280	0.1359	0.5081	0.8617	0.9566	0.9978	0.9989	0.9991	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1978	0.0028	0.0030	0.0058	0.1096	0.3922	0.7933	0.9663	0.9916	0.9997	0.9998	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1979	0.0000	0.0106	0.0175	0.0418	0.3447	0.7259	0.9344	0.9925	0.9984	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1980	0.0008	0.0004	0.0400	0.0961	0.2444	0.6921	0.9157	0.9815	0.9984	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1981	0.0123	0.0047	0.0048	0.1391	0.3878	0.7059	0.9057	0.9781	0.9949	0.9996	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1982	0.0014	0.0336	0.0275	0.0557	0.3852	0.7905	0.9468	0.9762	0.9946	0.9986	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1983	0.0002	0.0059	0.0888	0.1452	0.4197	0.7084	0.9574	0.9925	0.9943	0.9987	0.9996	1.0000	1.0000	1.0000	1.0000	1.0000
1984	0.0001	0.0012	0.0240	0.2143	0.5049	0.8987	0.9040	0.9926	0.9990	0.9987	0.9997	0.9999	1.0000	1.0000	1.0000	1.0000
1985	0.0003	0.0007	0.0066	0.0929	0.4331	0.8595	0.9909	0.9734	0.9987	0.9999	0.9997	0.9999	1.0000	1.0000	1.0000	1.0000
1986	0.0001	0.0020	0.0051	0.0366	0.2991	0.6814	0.9735	0.9993	0.9930	0.9998	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000
1987	0.0000	0.0012	0.0132	0.0370	0.1783	0.6400	0.8569	0.9955	0.9999	0.9982	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1988	0.0001	0.0004	0.0111	0.0818	0.2225	0.5536	0.8811	0.9437	0.9992	1.0000	0.9995	1.0000	1.0000	1.0000	1.0000	1.0000
1989	0.0006	0.0018	0.0053	0.0946	0.3719	0.6809	0.8764	0.9686	0.9792	0.9999	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000
1990	0.0002	0.0057	0.0233	0.0731	0.4931	0.7974	0.9409	0.9759	0.9923	0.9925	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1991	0.0024	0.0033	0.0515	0.2399	0.5395	0.9006	0.9632	0.9916	0.9957	0.9981	0.9973	1.0000	1.0000	1.0000	1.0000	1.0000
1992	0.0036	0.0158	0.0507	0.3408	0.8069	0.9457	0.9883	0.9943	0.9989	0.9992	0.9996	0.9990	1.0000	1.0000	1.0000	1.0000
1993	0.0000	0.0210	0.0957	0.4611	0.8310	0.9822	0.9962	0.9987	0.9991	0.9998	0.9999	0.9999	0.9997	1.0000	1.0000	1.0000
1994	0.0007	0.0005	0.1137	0.4107	0.9320	0.9791	0.9986	0.9997	0.9999	0.9999	1.0000	1.0000	1.0000	0.9999	1.0000	1.0000
1995	0.0027	0.0076	0.0154	0.4337	0.8210	0.9955	0.9978	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1996	0.0093	0.0163	0.0729	0.3523	0.8206	0.9679	0.9997	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1997	0.0044	0.0390	0.0923	0.4476	0.9497	0.9647	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1998	0.0019	0.0193	0.1488	0.3848	0.8931	0.9985	0.9939	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1999	0.0013	0.0115	0.0806	0.4297	0.7937	0.9885	1.0000	0.9990	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2000	0.0025	0.0125	0.0663	0.2807	0.7645	0.9594	0.9989	1.0000	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2001	0.0025	0.0144	0.1125	0.3017	0.6348	0.9333	0.9932	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0025	0.0144	0.0864	0.5599	0.7245	0.8856	0.9837	0.9989	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0025	0.0144	0.0864	0.3808	0.9274	0.9412	0.9718	0.9962	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2004	0.0025	0.0144	0.0864	0.3808	0.7622	0.9923	0.9898	0.9935	0.9991	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2005	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9992	0.9983	0.9985	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2006	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9999	0.9997	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2007	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	1.0000	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
2008	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	0.9994	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	0.9994	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	0.9994	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1959 to 2002 projected forward to 2010. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age (see Table 16). Shaded cells are averages of the first or last three estimates for the same age group; boxed cells are the average of adjacent estimates for the same age group.

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1959	0.0006	0.0040	0.0142	0.0677	0.1938	0.4701	0.7574	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1960	0.0000	0.0026	0.0149	0.0610	0.1804	0.4701	0.7574	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1961	0.0002	0.0001	0.0112	0.0536	0.2266	0.4003	0.7574	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1962	0.0007	0.0012	0.0010	0.0464	0.1744	0.5691	0.6693	0.9135	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1963	0.0004	0.0035	0.0102	0.0111	0.1733	0.4410	0.8562	0.8599	0.9724	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1964	0.0008	0.0028	0.0185	0.0785	0.1096	0.4745	0.7465	0.9641	0.9490	0.9914	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1965	0.0005	0.0046	0.0177	0.0914	0.4130	0.5741	0.7955	0.9166	0.9918	0.9826	0.9973	0.9992	0.9997	1.0000	1.0000	1.0000
1966	0.0001	0.0028	0.0252	0.1041	0.3491	0.8532	0.9365	0.9437	0.9762	0.9982	0.9942	0.9992	0.9997	1.0000	1.0000	1.0000
1967	0.0000	0.0010	0.0159	0.1255	0.4283	0.7410	0.9796	0.9938	0.9863	0.9935	0.9996	0.9981	0.9997	1.0000	1.0000	1.0000
1968	0.0009	0.0001	0.0066	0.0847	0.4435	0.8285	0.9385	0.9975	0.9994	0.9968	0.9983	0.9999	0.9994	1.0000	1.0000	1.0000
1969	0.0012	0.0044	0.0012	0.0438	0.3415	0.8157	0.9689	0.9879	0.9997	0.9999	0.9993	0.9995	1.0000	1.0000	1.0000	1.0000
1970	0.0001	0.0066	0.0205	0.0130	0.2395	0.7496	0.9609	0.9950	0.9977	1.0000	1.0000	0.9998	0.9999	1.0000	1.0000	1.0000
1971	0.0009	0.0012	0.0344	0.0899	0.1292	0.6839	0.9489	0.9927	0.9992	0.9996	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1972	0.0030	0.0049	0.0099	0.1616	0.3174	0.6250	0.9370	0.9915	0.9987	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1973	0.0054	0.0137	0.0257	0.0784	0.5103	0.6864	0.9493	0.9903	0.9986	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1974	0.0023	0.0198	0.0601	0.1241	0.4196	0.8493	0.9115	0.9853	0.9986	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1975	0.0016	0.0093	0.0697	0.2273	0.4324	0.8600	0.9682	0.9798	0.9996	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1976	0.0001	0.0067	0.0369	0.2176	0.5752	0.8038	0.9812	0.9940	0.9956	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1977	0.0005	0.0008	0.0280	0.1359	0.5081	0.8617	0.9566	0.9978	0.9989	0.9991	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1978	0.0028	0.0030	0.0058	0.1096	0.3922	0.7933	0.9663	0.9916	0.9997	0.9998	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1979	0.0000	0.0106	0.0175	0.0418	0.3447	0.7259	0.9344	0.9925	0.9984	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1980	0.0008	0.0004	0.0400	0.0961	0.2444	0.6921	0.9157	0.9815	0.9984	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1981	0.0123	0.0047	0.0048	0.1391	0.3878	0.7059	0.9057	0.9781	0.9949	0.9996	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1982	0.0014	0.0336	0.0275	0.0557	0.3852	0.7905	0.9468	0.9762	0.9946	0.9986	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1983	0.0002	0.0059	0.0888	0.1452	0.4197	0.7084	0.9574	0.9925	0.9943	0.9987	0.9996	1.0000	1.0000	1.0000	1.0000	1.0000
1984	0.0001	0.0012	0.0240	0.2143	0.5049	0.8987	0.9040	0.9926	0.9990	0.9997	0.9997	0.9999	1.0000	1.0000	1.0000	1.0000
1985	0.0003	0.0007	0.0066	0.0929	0.4331	0.8595	0.9909	0.9734	0.9987	0.9999	0.9997	0.9999	1.0000	1.0000	1.0000	1.0000
1986	0.0001	0.0020	0.0051	0.0366	0.2991	0.8814	0.9735	0.9993	0.9930	0.9998	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000
1987	0.0000	0.0012	0.0132	0.0370	0.1783	0.6400	0.8569	0.9955	0.9999	0.9982	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1988	0.0001	0.0004	0.0111	0.0818	0.2225	0.5536	0.8811	0.9437	0.9992	1.0000	0.9995	1.0000	1.0000	1.0000	1.0000	1.0000
1989	0.0006	0.0018	0.0053	0.0946	0.3719	0.6809	0.8764	0.9686	0.9792	0.9999	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000
1990	0.0002	0.0057	0.0233	0.0731	0.4931	0.7974	0.9409	0.9759	0.9923	0.9925	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1991	0.0024	0.0033	0.0515	0.2399	0.5395	0.9006	0.9632	0.9916	0.9967	0.9981	0.9973	1.0000	1.0000	1.0000	1.0000	1.0000
1992	0.0036	0.0158	0.0507	0.3408	0.8069	0.9457	0.9883	0.9943	0.9989	0.9992	0.9996	0.9990	1.0000	1.0000	1.0000	1.0000
1993	0.0000	0.0210	0.0957	0.4611	0.8310	0.9822	0.9962	0.9987	0.9991	0.9998	0.9999	0.9999	0.9997	1.0000	1.0000	1.0000
1994	0.0007	0.0005	0.1137	0.4107	0.9320	0.9791	0.9986	0.9997	0.9999	0.9999	1.0000	1.0000	1.0000	0.9999	1.0000	1.0000
1995	0.0027	0.0076	0.0154	0.4337	0.8210	0.9955	0.9978	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1996	0.0093	0.0163	0.0729	0.3523	0.8206	0.9679	0.9997	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1997	0.0044	0.0390	0.0923	0.4476	0.9497	0.9647	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1998	0.0019	0.0193	0.1488	0.3848	0.8931	0.9985	0.9939	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1999	0.0013	0.0115	0.0806	0.4297	0.7937	0.9885	1.0000	0.9990	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2000	0.0025	0.0125	0.0663	0.2807	0.7645	0.9594	0.9989	1.0000	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2001	0.0025	0.0144	0.1125	0.3017	0.6348	0.9333	0.9932	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0025	0.0144	0.0864	0.5599	0.7245	0.8856	0.9837	0.9989	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0025	0.0144	0.0864	0.3808	0.9274	0.9412	0.9718	0.9962	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2004	0.0025	0.0144	0.0864	0.3808	0.7622	0.9923	0.9898	0.9935	0.9991	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2005	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9992	0.9983	0.9985	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2006	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9999	0.9997	0.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2007	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	1.0000	1.0000	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
2008	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	0.9994	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	0.9994	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.0025	0.0144	0.0864	0.3808	0.7622	0.9397	0.9870	0.9973	0.9994	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 18. Quasi-likelihood SPA for 3Ps cod October 2002. Output from Run A-comparison run.(note that there was no "preferred" run in this assessment and results are presented here for illustrative purposes only).

Cohort model for years 1959 - 2002 , and ages 2 - 14

Cameron RV index for years 1972 to 1982 , and ages 2 to 14. Var = Quadratic

Can RV Burgeo index for years 1993 to 2002 , and ages 2 to 12. Var = Quadratic

Can RV No Burgeo index for years 1983 to 2002 , and ages 2 to 14. Var = Quadratic

Sentinel gillnet index for years 1995 to 2001 , and ages 3 to 10. Var = Quadratic

Sentinel linetrawl index for years 1995 to 2001 , and ages 3 to 9. Var = Quadratic

Extended Deviance = 1018.1 , df = 533 , #Parms = 27

Penalty = 0.00

Var scale =		
	Cameron RV	0.417
	Can RV Burgeo	0.788
	Can RV No Burgeo	0.545
	Sentinel gillnet	0.428
	Sentinel linetrawl	0.300

Quadratic Var	Beta	Std. Err	95% L	95% U
Cameron RV	1.204	0.054	1.082	1.339
Can RV Burgeo	1.195	0.093	0.997	1.433
Can RV No Burgeo	1.269	0.062	1.124	1.433
Sentinel gillnet	1.142	0.093	0.953	1.369
Sentinel linetrawl	1.017	0.014	0.989	1.045

Age	Survivors	CV	95% L	95% U
2	18972.22	0.61	5766.68	62418.07
3	38837.76	0.44	16540.95	91190.12
4	45768.99	0.30	25405.37	82455.01
5	25023.16	0.25	15218.99	41143.25
6	7824.30	0.25	4831.38	12671.28
7	5107.97	0.27	2980.08	8755.25
8	2889.37	0.33	1521.79	5485.94
9	1545.04	0.40	705.54	3383.44
10	1552.66	0.40	704.34	3422.74
11	883.15	0.45	367.66	2121.39
12	1860.99	0.41	829.48	4175.23
13	3292.55	0.35	1661.95	6522.97

Table 18. Cont'd.

Year Effect	Constraint	Effect	CV	95% L	95% U
			1.00	1.00	1.00

F Constraint	Estimate	CV	95% L	95% U
F10_ratio_in_1993	0.3140	0.727	0.076	1.306
F11_ratio_in_1993	0.2470	0.514	0.090	0.677
F12_ratio_in_1993	0.1770	0.614	0.053	0.589
F13_ratio_in_1993	0.3230	0.616	0.097	1.081
F14_ratio_in_1959-1993	0.4300	0.088	0.362	0.512
F14_ratio_in_1998	0.1090	0.507	0.040	0.294
F14_ratio_in_1999	0.5780	0.407	0.260	1.283
F14_ratio_in_2000	0.4050	0.297	0.226	0.725
F14_ratio_in_2001	0.1690	0.259	0.102	0.280
F14_ratio_in_2002	0.2080	0.295	0.117	0.371

Q_CONST	Estm (X1000)	CV	95% L	95% U
Cameron_a=02	0.0288	0.01	0.018	0.0396
Cameron_a=03	0.0457	0.01	0.0287	0.0627
Cameron_a=04	0.1065	0.02	0.0677	0.1454
Cameron_a=05	0.1547	0.03	0.0981	0.2113
Cameron_a=06	0.1150	0.02	0.0712	0.1589
Cameron_a=07	0.1195	0.02	0.0718	0.1672
Cameron_a=08	0.1188	0.03	0.0669	0.1706
Cameron_a=09	0.1508	0.04	0.0801	0.2215
Cameron_a=10	0.1310	0.04	0.0565	0.2056
Cameron_a=11	0.1060	0.04	0.0271	0.1849
Cameron_a=12	0.1013	0.05	0.0106	0.1919
Cameron_a=13	0.0753	0.05	-0.0181	0.1687
Cameron_a=14	0.0505	0.04	-0.0358	0.1368
CanRV_B_a=02	0.0501	0.02	0.0171	0.0831
CanRV_B_a=03	0.4057	0.11	0.1948	0.6165
CanRV_B_a=04	0.5653	0.15	0.2719	0.8588
CanRV_B_a=05	0.7281	0.19	0.3499	1.1063
CanRV_B_a=06	0.7984	0.21	0.3824	1.2144
CanRV_B_a=07	0.9104	0.24	0.434	1.3868
CanRV_B_a=08	0.5767	0.16	0.2651	0.8883
CanRV_B_a=09	0.4125	0.12	0.1754	0.6496
CanRV_B_a=10	0.2112	0.07	0.0715	0.351
CanRV_B_a=11	0.2230	0.08	0.0692	0.3768
CanRV_B_a=12	0.0693	0.03	0.0013	0.1372
CanRV_NoB_Camp_a=13	0.0359	0.03	-0.0164	0.0882
CanRV_NoB_Camp_a=14	0.0212	0.03	-0.0292	0.0716
CanRV_NoB_Engl_a=13	0.0869	0.03	0.0218	0.1521
CanRV_NoB_Engl_a=14	0.0927	0.04	0.0166	0.1689
CanRV_NoB_a=02	0.0655	0.02	0.0306	0.1005
CanRV_NoB_a=03	0.1272	0.02	0.0894	0.165
CanRV_NoB_a=04	0.1351	0.02	0.0948	0.1754
CanRV_NoB_a=05	0.1919	0.03	0.1346	0.2491
CanRV_NoB_a=06	0.2113	0.03	0.1473	0.2753

Table 18. Cont'd.

CanRV_NoB_a=07	0.1825	0.03	0.1243	0.2406
CanRV_NoB_a=08	0.2271	0.04	0.1517	0.3026
CanRV_NoB_a=09	0.2241	0.04	0.1446	0.3035
CanRV_NoB_a=10	0.1448	0.03	0.0855	0.2040
CanRV_NoB_a=11	0.1249	0.03	0.0685	0.1813
CanRV_NoB_a=12	0.1111	0.03	0.0543	0.1678
Sent_gill_a=03	0.0005	0.00	-0.0003	0.0014
Sent_gill_a=04	0.0076	0.00	0.0022	0.0129
Sent_gill_a=05	0.1671	0.04	0.0866	0.2476
Sent_gill_a=06	0.4265	0.10	0.2252	0.6278
Sent_gill_a=07	0.5035	0.12	0.2648	0.7422
Sent_gill_a=08	0.3594	0.09	0.1853	0.5335
Sent_gill_a=09	0.1502	0.04	0.0705	0.2299
Sent_gill_a=10	0.0891	0.03	0.0340	0.1441
Sent_line_a=03	0.0005	0.00	0.0004	0.0007
Sent_line_a=04	0.002	0.00	0.0016	0.0025
Sent_line_a=05	0.0032	0.00	0.0025	0.0039
Sent_line_a=06	0.0033	0.00	0.0025	0.0040
Sent_line_a=07	0.0025	0.00	0.0019	0.0031
Sent_line_a=08	0.0024	0.00	0.0017	0.0030
Sent_line_a=09	0.0013	0.00	0.0008	0.0018

Table 18. Cont'd

Population numbers at age

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	2+
1959	77878	60749	118000	45578	24347	16929	6401	4148	4550	6921	1734	433	12	367884
1960	64054	63761	48831	84165	30507	13360	9450	4388	2263	2585	5096	926	315	329700
1961	60812	52443	51690	35007	47460	18902	7793	4584	2670	1105	1749	3804	502	288520
1962	53287	49789	42529	37266	19290	24416	12204	2146	2080	941	501	1192	2607	248247
1963	86809	43627	39637	28713	22364	11691	14819	8755	1041	1186	601	283	854	260382
1964	101000	71074	34850	28381	17092	13537	7285	9391	6355	588	842	402	135	290878
1965	106000	82647	56466	23298	18138	9308	8419	4263	5978	4613	175	392	281	319531
1966	122000	86422	65572	37511	13828	11584	4676	5033	2388	3959	3481	81	210	356704
1967	88080	99851	69897	41324	18890	7140	4853	2394	2462	1015	2774	2498	38	341215
1968	70385	72114	79153	47353	22160	9682	3720	2739	1413	1730	487	2185	1911	315032
1969	43973	57627	58007	53402	26884	12847	4695	1862	1746	772	1216	298	1784	265115
1970	75482	36002	46480	41070	33240	15516	6398	2254	808	780	577	887	184	259678
1971	51003	61800	28792	30713	21938	18380	6936	3016	1185	468	478	403	616	225728
1972	42908	41758	47988	17742	17388	11387	7613	2846	1316	481	306	278	274	192283
1973	52073	35130	33527	34816	10372	11022	5158	3848	1576	658	208	145	184	188716
1974	75018	42633	27907	23190	18202	4863	5385	2231	1323	824	383	71	106	202138
1975	83894	61420	33198	17381	9950	9143	1684	2728	787	597	450	241	29	221502
1976	103000	68687	48621	20549	9347	4038	2177	724	1152	550	331	321	192	259304
1977	60470	84015	52517	28824	9655	5051	2125	1335	466	895	435	252	259	246299
1978	34839	49509	67940	34713	16065	5001	3303	1382	853	276	681	317	178	215057
1979	50531	28523	40080	50968	22904	9528	2508	2114	919	537	161	533	244	209551
1980	88113	41371	23231	30035	32390	14169	5672	1401	1520	676	392	110	425	239505
1981	55110	72141	33539	17549	20018	19139	8543	3539	851	1141	503	280	71	232395
1982	88840	45121	58139	24846	11531	12180	10372	5527	2385	539	874	380	213	260946
1983	80902	72736	36824	42993	16334	7316	7383	5832	3946	1733	366	688	301	277355
1984	69439	66237	58864	27722	26899	9681	4405	5004	3833	3010	1337	266	547	277243
1985	33152	56852	54047	44103	18591	15673	5917	3078	3607	2833	2343	1063	211	241466
1986	44444	27142	46409	41862	28841	10566	8089	3505	1953	2460	2000	1820	851	219942
1987	58566	36388	21945	33379	24996	13454	4776	4662	2281	1397	1859	1508	1418	206629
1988	63993	47950	29263	15293	17354	11631	6081	2629	2815	1559	1009	1452	1112	202140
1989	60316	52393	38412	19478	8023	8353	4957	3356	1582	2048	1165	758	1141	201982
1990	28329	49382	41927	23310	8852	3978	4533	3052	2205	1094	1549	903	594	169707
1991	57775	23194	38616	26525	11669	4235	1915	2592	1873	1489	767	1174	696	172520
1992	30807	47302	18255	24394	12643	4209	1509	838	1561	1146	1121	559	916	145261
1993	17407	25222	37441	11183	12350	4436	1396	640	442	1104	769	843	427	113660
1994	29292	14251	20399	27295	7314	7256	2425	780	444	328	857	618	677	111936
1995	21885	23982	11660	16630	22191	5921	5884	1960	628	361	267	702	506	112577
1996	19477	17918	19632	9540	13565	18061	4796	4784	1598	512	295	218	574	110972
1997	19228	15946	14662	16035	7772	11015	14674	3895	3895	1301	418	241	179	109260
1998	19478	15743	12996	11618	12106	5913	8170	11267	3020	3105	1037	338	196	104987
1999	46481	15947	12807	10303	8794	8509	3984	5500	8123	2269	2434	799	263	126212
2000	68388	38055	13012	9917	7348	5249	4866	2339	3635	5861	1687	1893	635	162884
2001	47439	55991	31088	10350	7453	4792	2767	2641	1363	2496	4234	1298	1516	173429
2002	18972	38838	45769	25023	7824	5108	2889	1545	1553	883	1861	3293	1037	154595
2002 3	18047	36943	43503	23668	7304	4762	2628	1392	1438	812	1745	3106	983	146329

Table 18. Cont'd.

Fishing mortalities

Year	2	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.000	0.018	0.140	0.201	0.400	0.383	0.178	0.406	0.365	0.106	0.427	0.119	0.094
1960	0.000	0.010	0.133	0.373	0.279	0.339	0.523	0.297	0.517	0.191	0.092	0.412	0.100
1961	0.000	0.010	0.127	0.396	0.465	0.238	1.090	0.590	0.843	0.591	0.183	0.178	0.137
1962	0.000	0.028	0.193	0.311	0.301	0.299	0.132	0.523	0.361	0.248	0.370	0.134	0.108
1963	0.000	0.025	0.134	0.319	0.302	0.273	0.256	0.120	0.371	0.143	0.201	0.540	0.127
1964	0.000	0.030	0.203	0.248	0.408	0.275	0.336	0.252	0.120	1.014	0.565	0.161	0.249
1965	0.000	0.031	0.209	0.322	0.248	0.488	0.314	0.379	0.212	0.082	0.562	0.422	0.153
1966	0.000	0.012	0.262	0.486	0.461	0.670	0.470	0.515	0.656	0.156	0.132	0.569	0.123
1967	0.000	0.032	0.189	0.423	0.468	0.452	0.372	0.327	0.153	0.534	0.039	0.068	0.092
1968	0.000	0.018	0.194	0.366	0.345	0.524	0.492	0.250	0.404	0.153	0.290	0.003	0.064
1969	0.000	0.015	0.145	0.274	0.350	0.497	0.534	0.635	0.605	0.091	0.116	0.285	0.071
1970	0.000	0.023	0.214	0.427	0.392	0.605	0.552	0.443	0.346	0.290	0.159	0.163	0.088
1971	0.000	0.053	0.284	0.369	0.456	0.681	0.691	0.630	0.702	0.224	0.341	0.186	0.108
1972	0.000	0.020	0.121	0.337	0.256	0.592	0.482	0.391	0.493	0.638	0.549	0.212	0.200
1973	0.000	0.030	0.169	0.449	0.557	0.516	0.638	0.867	0.448	0.341	0.878	0.113	0.191
1974	0.000	0.050	0.273	0.646	0.489	0.861	0.480	0.842	0.597	0.406	0.262	0.693	0.195
1975	0.000	0.034	0.280	0.420	0.702	1.235	0.644	0.663	0.159	0.389	0.137	0.028	0.079
1976	0.000	0.068	0.323	0.555	0.415	0.442	0.289	0.240	0.052	0.035	0.073	0.014	0.017
1977	0.000	0.012	0.214	0.385	0.458	0.225	0.230	0.248	0.325	0.073	0.116	0.146	0.048
1978	0.000	0.011	0.087	0.216	0.322	0.490	0.247	0.208	0.262	0.340	0.045	0.061	0.064
1979	0.000	0.005	0.089	0.253	0.280	0.319	0.382	0.130	0.106	0.115	0.180	0.027	0.046
1980	0.000	0.010	0.080	0.206	0.326	0.306	0.280	0.298	0.087	0.096	0.136	0.237	0.067
1981	0.000	0.016	0.100	0.220	0.297	0.413	0.236	0.186	0.258	0.067	0.080	0.074	0.032
1982	0.000	0.003	0.102	0.219	0.255	0.301	0.376	0.137	0.119	0.187	0.039	0.032	0.037
1983	0.000	0.012	0.084	0.269	0.323	0.307	0.189	0.220	0.071	0.060	0.119	0.029	0.030
1984	0.000	0.003	0.089	0.200	0.340	0.292	0.158	0.127	0.103	0.050	0.029	0.034	0.016
1985	0.000	0.003	0.055	0.225	0.365	0.461	0.324	0.255	0.183	0.148	0.053	0.022	0.032
1986	0.000	0.013	0.130	0.316	0.563	0.594	0.351	0.229	0.136	0.080	0.082	0.049	0.030
1987	0.000	0.018	0.161	0.454	0.565	0.594	0.397	0.304	0.181	0.125	0.047	0.104	0.040
1988	0.000	0.022	0.207	0.445	0.531	0.653	0.394	0.308	0.118	0.091	0.086	0.041	0.031
1989	0.000	0.023	0.299	0.589	0.502	0.411	0.285	0.220	0.169	0.079	0.056	0.043	0.026
1990	0.000	0.046	0.258	0.492	0.537	0.531	0.359	0.288	0.193	0.155	0.077	0.059	0.042
1991	0.000	0.039	0.259	0.541	0.820	0.832	0.627	0.307	0.291	0.084	0.116	0.048	0.036
1992	0.000	0.014	0.290	0.481	0.847	0.904	0.657	0.438	0.146	0.199	0.085	0.070	0.051
1993	0.000	0.012	0.116	0.225	0.332	0.404	0.382	0.167	0.100	0.053	0.019	0.019	0.013
1994	0.000	0.001	0.004	0.007	0.011	0.009	0.013	0.017	0.007	0.007	0.000	0.000	0.000
1995	0.000	0.000	0.001	0.004	0.006	0.011	0.007	0.004	0.004	0.000	0.000	0.000	0.000
1996	0.000	0.001	0.002	0.005	0.008	0.008	0.008	0.006	0.006	0.004	0.004	0.000	0.000
1997	0.000	0.005	0.033	0.081	0.073	0.099	0.064	0.055	0.027	0.027	0.011	0.005	0.000
1998	0.000	0.006	0.032	0.078	0.153	0.195	0.196	0.127	0.086	0.044	0.062	0.050	0.006
1999	0.000	0.003	0.056	0.138	0.316	0.359	0.333	0.214	0.126	0.097	0.051	0.029	0.034
2000	0.000	0.002	0.029	0.086	0.227	0.440	0.411	0.340	0.176	0.125	0.062	0.022	0.028
2001	0.000	0.002	0.017	0.080	0.178	0.306	0.383	0.331	0.234	0.094	0.051	0.024	0.010
2002	0.000	0.000	0.001	0.006	0.019	0.020	0.045	0.055	0.027	0.034	0.014	0.008	0.004

Table 18. Cont'd.

Biomass at age

	2	3	4	5	6	7	8	9	10	11	12	13	14	2+
1959	0	10813	65249	39471	34231	35129	18178	15276	21215	38736	11318	3266	106	292991
1960	0	11349	21486	72634	41093	26826	26232	15920	10329	14307	33106	6954	2701	282938
1961	0	9335	22744	30211	63929	37956	21633	16632	12185	6114	11362	28554	4314	264966
1962	0	8862	18713	32160	25983	49027	33878	7784	9494	5207	3254	8949	22390	225702
1963	0	7766	17440	24780	30125	23476	41137	31763	4751	6567	3905	2127	7332	201167
1964	0	12651	15334	24493	23023	27183	20225	34071	29006	3255	5470	3021	1161	198892
1965	0	14711	24845	20106	24432	18690	23370	15466	27282	25535	1135	2940	2410	200922
1966	0	15383	28852	32372	18626	23261	12981	18261	10899	21915	22617	612	1806	207585
1967	0	17773	30755	35662	25444	14337	13471	8684	11238	5618	18022	18754	324	200083
1968	0	12836	34827	40865	29850	19441	10327	9936	6450	9576	3165	16404	16406	210084
1969	0	10258	25523	46086	36213	25798	13033	6756	7967	4275	7898	2240	15323	201370
1970	0	6408	20451	35443	44774	31156	17761	8177	3688	4319	3750	6656	1578	184162
1971	0	11000	12668	26505	29551	36908	19254	10942	5408	2590	3105	3025	5293	166249
1972	0	7433	21115	15311	23421	22865	21133	10324	6004	2660	1989	2088	2351	136694
1973	0	6253	14752	30046	13971	22132	14318	13959	7193	3643	1351	1087	1582	130288
1974	0	7589	12279	20013	24518	9766	14948	8096	6039	4563	2490	531	909	111741
1975	0	10933	14607	15000	13403	18360	4674	9898	3593	3302	2921	1812	249	98751
1976	0	12364	21393	17733	12591	8107	6044	2627	5256	3042	2151	2410	1650	95368
1977	0	40999	22897	27296	13681	10699	6088	4894	2098	4907	2775	1976	2428	140739
1978	0	18516	42123	29749	24227	10677	9332	5177	3966	1394	4447	2294	1560	153460
1979	0	8814	21683	42864	30577	20124	7532	7580	4740	3229	1046	4416	2237	154844
1980	0	17459	12614	25740	41945	28663	17187	6247	8308	4653	3048	961	4059	170683
1981	0	27341	21498	17111	28545	37398	24330	13904	4715	8188	4085	2385	670	190170
1982	0	14845	35349	23877	17677	25103	26697	19763	11446	3192	6982	3361	2085	190375
1983	0	31495	22647	43509	24925	15678	20481	19218	17515	10200	2644	6408	3046	217766
1984	0	38550	45737	30051	43549	22189	13738	19692	17549	16585	10294	2589	5596	266099
1985	0	32803	40481	49880	29429	36878	17833	13388	19271	16511	15390	10008	2282	284154
1986	0	12268	31883	41904	43378	22042	24063	13480	10265	15003	14596	13834	9199	251914
1987	0	16848	14155	31810	34670	27742	12937	17215	10696	8156	12221	11847	11621	209917
1988	0	26660	19840	14008	24678	21879	15792	8643	13072	8349	6452	10475	8640	178688
1989	0	28240	27426	18991	10694	16188	13404	11626	6813	11461	7457	5421	9204	166927
1990	0	25185	30858	23636	12968	7948	11776	11510	10086	6272	10709	7030	5328	163306
1991	0	12942	25486	26605	17352	8868	5113	8623	7913	8457	5355	9513	6259	142487
1992	0	17833	11774	21516	17081	8284	3951	2908	7058	5973	7895	4996	9280	118549
1993	0	5902	20930	9673	15302	8082	3500	2269	1867	5626	5335	6166	3952	88603
1994	0	7482	10974	25685	10350	12654	5860	2484	1934	1705	5169	4406	5035	93740
1995	0	9065	8442	18826	36083	12689	14064	6042	2468	1559	1364	4624	4006	119231
1996	0	10464	14057	10713	24322	40890	12926	14343	5968	2332	1320	1199	4278	142813
1997	0	7654	11407	18167	12956	24971	41982	12446	13147	5595	2313	1526	1577	153740
1998	0	8013	10306	13790	19793	12584	22787	40774	11434	12529	5071	2157	1789	161026
1999	0	9871	9669	13033	16744	19374	10405	19174	37659	10301	12007	4517	1795	164550
2000	0	18190	10305	11087	13233	13207	12983	6971	15429	34566	9324	11013	4375	160685
2001	0	31411	24622	11758	12082	11056	8453	7932	4497	12659	31761	8858	10948	176036
2002	0	21477	38721	32155	13536	11003	8108	5741	5433	3398	11415	30486	8630	190102
2002.3	0	20429	36803	30414	12636	10258	7373	5171	5031	3124	10703	28755	8177	178874

Table 18. Cont'd.

Spawner biomass at age

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	2+
1959	0	0	652	2763	6504	16510	13815	13902	20578	38350	11318	3266	106	127766
1960	0	0	215	4358	7397	12608	19936	14487	10019	14164	33106	6954	2701	125945
1961	0	0	227	1511	14704	15182	16441	15135	11819	6053	11362	28554	4314	125301
1962	0	0	0	1606	4417	27945	22698	7084	9209	5155	3254	8949	22390	112709
1963	0	0	174	248	5121	10329	35378	27316	4608	6501	3905	2127	7332	103040
1964	0	0	307	1959	2533	12776	15168	32708	27555	3222	5470	3021	1161	105881
1965	0	0	497	1810	10017	10653	18696	14228	27009	25024	1135	2940	2410	114420
1966	0	0	866	3237	6519	19772	12202	17165	10681	21915	22391	612	1806	117166
1967	0	0	615	4636	10941	10609	13201	8597	11126	5562	18022	18754	324	102388
1968	0	0	348	3269	13134	16136	9707	9936	6450	9576	3165	16404	16406	104532
1969	0	0	0	1843	12312	21154	12642	6689	7967	4275	7898	2240	15323	92344
1970	0	64	409	354	10746	23367	17050	8177	3688	4319	3750	6656	1578	80159
1971	0	0	380	2385	3842	25097	18291	10832	5408	2590	3105	3025	5293	80249
1972	0	0	211	2450	7495	14405	19865	10220	6004	2660	1989	2088	2351	69739
1973	0	63	443	2404	7125	15271	13603	13819	7193	3543	1351	1087	1582	67584
1974	0	152	737	2402	10298	8301	13603	8096	6039	4563	2490	531	909	58119
1975	0	109	1022	3450	5763	15789	4533	9700	3593	3302	2921	1812	249	52245
1976	0	124	856	3901	7303	6486	5923	2601	5256	3042	2151	2410	1650	41702
1977	0	0	687	3821	6977	9201	5844	4894	2098	4907	2775	1976	2428	45609
1978	0	0	421	3272	9448	8435	9052	5125	3966	1394	4447	2294	1560	49414
1979	0	88	434	1715	10396	14691	7005	7504	4740	3229	1046	4416	2237	57502
1980	0	0	505	2574	10067	19777	15812	6122	8308	4653	3048	961	4059	75885
1981	0	0	0	2395	11133	26552	22140	13626	4668	8188	4085	2385	670	95842
1982	0	445	1060	1433	6894	19831	25362	19368	11331	3192	6982	3361	2085	101344
1983	0	315	2038	6526	10469	11131	19662	19026	17340	10200	2644	6408	3046	108805
1984	0	0	915	6311	21775	19970	12364	19495	17549	16565	10294	2589	5596	133422
1985	0	0	405	4489	12655	31715	17654	12986	19271	16511	15390	10008	2282	143366
1986	0	0	319	1676	13013	14988	23341	13480	10162	15003	14596	13834	9199	129612
1987	0	0	142	1272	6241	17755	11126	17215	10696	8156	12221	11847	11621	108291
1988	0	0	198	1121	5429	12033	13897	8125	13072	8349	6452	10475	8840	87992
1989	0	0	274	1709	3957	11008	11796	11278	6677	11461	7457	5421	9204	80241
1990	0	252	617	1655	6354	6358	11069	11280	9985	6209	10709	7030	5328	76847
1991	0	0	1274	6385	9370	7981	4908	8536	7913	8457	5355	9513	6259	75953
1992	0	357	589	7315	13836	7870	3912	2879	7058	5973	7895	4996	9280	71958
1993	0	118	2093	4450	12700	7920	3500	2269	1867	5626	5335	6166	3952	55996
1994	0	0	1207	10531	9625	12401	5860	2484	1934	1705	5169	4406	5035	60359
1995	0	91	169	8095	29588	12689	14064	6042	2468	1559	1364	4624	4006	84758
1996	0	209	984	3750	19944	39663	12926	14343	5968	2332	1320	1199	4278	106917
1997	0	306	1027	8175	12308	23972	41562	12446	13147	5595	2313	1526	1577	123953
1998	0	160	1546	5240	17615	12584	22559	40774	11434	12529	5071	2157	1789	133458
1999	0	99	774	5604	13228	19180	10405	19174	37659	10301	12007	4517	1795	134744
2000	0	182	721	3104	10057	12679	12983	6971	15429	34566	9324	11013	4375	121405
2001	0	314	2708	3527	7612	10282	8368	7932	4497	12659	31761	8858	10948	109466
2002	0	215	3485	18007	9746	9792	7945	5741	5433	3398	11415	30486	8630	114293
2002 3	0	204	3312	17032	9098	9130	7225	5171	5031	3124	10703	28755	8177	106962

Table 18. Cont'd.

Standardized Cameron RV residuals. MSE=1.

	2	3	4	5	6	7	8	9	10	11	12	13	14
1972 2	0.03	0.08	-0.62	-0.65	-0.90	0.09	0.48	0.43	0.37	1.76	-0.14	-0.24	-0.09
1973 2	0.16	0.31	-0.44	-1.07	-1.38	-1.36	-1.44	-1.39	-0.65	-0.69	0.08	-0.01	-0.34
1974 3	2.03	2.25	-0.59	-0.46	0.36	0.85	-0.56	0.33	-0.05	0.33	0.12	-0.24	1.36
1975 4	-1.17	-0.51	-1.00	-1.17	-0.49	-0.13	0.67	-0.72	-0.41	-0.45	-0.69	0.38	-0.14
1976 4	0.19	-0.35	-0.06	0.02	0.54	0.83	2.15	0.81	-0.29	0.25	1.21	-0.53	-0.35
1977 3	-1.07	0.50	-0.32	-0.62	-0.07	-0.49	-0.12	1.54	0.56	-0.72	0.00	0.08	-0.40
1978 2	-0.57	-0.74	-0.88	-1.50	-1.28	-0.86	-0.56	-0.14	0.56	0.30	-0.84	-0.54	-0.34
1979 2	-0.81	-0.20	4.50	4.15	0.22	-0.93	-0.55	-0.69	0.15	-0.05	-0.15	-0.50	0.28
1980 2	2.07	-0.33	-0.88	-0.16	-0.24	-1.02	-0.27	-0.01	-0.18	0.53	0.41	0.95	-0.51
1981 2	-0.84	-0.19	0.49	2.21	3.47	2.86	-0.28	0.87	1.14	-0.84	0.95	1.52	1.70
1982 4	-0.08	-0.79	-0.22	-0.82	-0.32	0.16	0.81	-0.53	-0.73	0.17	-0.57	-0.35	0.01

Unstandardized Cameron RV residuals. MSE=4.10.

	2	3	4	5	6	7	8	9	10	11	12	13	14
1972 2	0.02	0.09	-1.77	-0.98	-1.02	0.07	0.25	0.12	0.05	0.11	-0.01	-0.01	0.00
1973 2	0.15	0.30	-0.89	-3.04	-0.92	-0.99	-0.52	-0.46	-0.10	-0.05	0.00	0.00	-0.01
1974 3	2.55	2.52	-0.93	-0.77	0.38	0.26	-0.20	0.06	-0.01	0.03	0.01	0.00	0.03
1975 4	-1.61	-0.80	-1.78	-1.51	-0.26	-0.06	0.09	-0.16	-0.04	-0.03	-0.04	0.01	0.00
1976 4	0.31	-0.61	-0.16	0.03	0.30	0.23	0.38	0.08	-0.04	0.02	0.06	-0.02	-0.01
1977 3	-1.10	1.09	-0.94	-1.41	-0.04	-0.18	-0.02	0.23	0.04	-0.07	0.00	0.00	-0.01
1978 2	-0.35	-0.99	-3.61	-4.44	-1.32	-0.31	-0.15	-0.02	0.06	0.01	-0.07	-0.02	-0.01
1979 2	-0.72	-0.16	10.95	17.85	0.32	-0.62	-0.12	-0.16	0.02	0.00	-0.01	-0.03	0.01
1980 2	3.09	-0.37	-1.27	-0.40	-0.48	-0.96	-0.11	0.00	-0.03	0.04	0.02	0.02	-0.02
1981 2	-0.80	-0.37	1.01	3.38	4.47	3.58	-0.17	0.30	0.12	-0.09	0.06	0.06	0.03
1982 4	-0.12	-0.93	-0.72	-1.62	-0.23	0.12	0.51	-0.26	-0.16	0.01	-0.05	-0.02	0.00

Table 18. Cont'd.

Standardized Cameron RV residuals. MSE=1.

	2	3	4	5	6	7	8	9	10	11	12	13	14
1972.2	0.03	0.08	-0.62	-0.85	-0.90	0.09	0.48	0.43	0.37	1.76	-0.14	-0.24	-0.09
1973.2	0.16	0.31	-0.44	-1.07	-1.38	-1.36	-1.44	-1.39	-0.65	-0.69	0.08	-0.01	-0.34
1974.3	2.03	2.25	-0.59	-0.46	0.36	0.85	-0.56	0.33	-0.05	0.33	0.12	-0.24	1.36
1975.4	-1.17	-0.51	-1.00	-1.17	-0.49	-0.13	0.67	-0.72	-0.41	-0.45	-0.69	0.38	-0.14
1976.4	0.19	-0.35	-0.06	0.02	0.54	0.83	2.15	0.81	-0.29	0.25	1.21	-0.53	-0.35
1977.3	-1.07	0.50	-0.32	-0.62	-0.07	-0.49	-0.12	1.54	0.56	-0.72	0.00	0.08	-0.40
1978.2	-0.57	-0.74	-0.88	-1.50	-1.28	-0.86	-0.56	-0.14	0.56	0.30	-0.84	-0.54	-0.34
1979.2	-0.81	-0.20	4.50	4.15	0.22	-0.93	-0.55	-0.69	0.15	-0.05	-0.15	-0.50	0.28
1980.2	2.07	-0.33	-0.88	-0.16	-0.24	-1.02	-0.27	-0.01	-0.18	0.53	0.41	0.95	-0.51
1981.2	-0.84	-0.19	0.49	2.21	3.47	2.86	-0.28	0.87	1.14	-0.84	0.95	1.52	1.70
1982.4	-0.08	-0.79	-0.22	-0.82	-0.32	0.16	0.81	-0.53	-0.73	0.17	-0.57	-0.35	0.01

Unstandardized Cameron RV residuals. MSE=4.10.

	2	3	4	5	6	7	8	9	10	11	12	13	14
1972.2	0.02	0.09	-1.77	-0.98	-1.02	0.07	0.25	0.12	0.05	0.11	-0.01	-0.01	0.00
1973.2	0.15	0.30	-0.89	-3.04	-0.92	-0.99	-0.52	-0.46	-0.10	-0.05	0.00	0.00	-0.01
1974.3	2.55	2.52	-0.93	-0.77	0.38	0.26	-0.20	0.06	-0.01	0.03	0.01	0.00	0.03
1975.4	-1.61	-0.80	-1.78	-1.51	-0.26	-0.06	0.09	-0.16	-0.04	-0.03	-0.04	0.01	0.00
1976.4	0.31	-0.61	-0.16	0.03	0.30	0.23	0.38	0.08	-0.04	0.02	0.06	-0.02	-0.01
1977.3	-1.10	1.09	-0.94	-1.41	-0.04	-0.18	-0.02	0.23	0.04	-0.07	0.00	0.00	-0.01
1978.2	-0.35	-0.99	-3.61	-4.44	-1.32	-0.31	-0.15	-0.02	0.06	0.01	-0.07	-0.02	-0.01
1979.2	-0.72	-0.16	10.95	17.85	0.32	-0.62	-0.12	-0.16	0.02	0.00	-0.01	-0.03	0.01
1980.2	3.09	-0.37	-1.27	-0.40	-0.48	-0.98	-0.11	0.00	-0.03	0.04	0.02	0.02	-0.02
1981.2	-0.80	-0.37	1.01	3.38	4.47	3.58	-0.17	0.30	0.12	-0.09	0.06	0.06	0.03
1982.4	-0.12	-0.93	-0.72	-1.62	-0.23	0.12	0.51	-0.26	-0.16	0.01	-0.05	-0.02	0.00

Cameron RV Index

Year	2	3	4	5	6	7	8	9	10	11	12	13	14
1972.2	1.21	1.92	3.02	1.49	0.81	1.23	1.04	0.50	0.20	0.15	0.02	0.01	0.01
1973.2	1.59	1.83	2.43	1.69	0.11	0.15	0.00	0.01	0.08	0.01	0.02	0.01	0.00
1974.3	4.58	4.33	1.65	2.01	2.08	0.68	0.32	0.31	0.13	0.10	0.04	0.00	0.03
1975.4	0.62	1.76	1.14	0.59	0.54	0.56	0.23	0.13	0.05	0.02	0.00	0.03	0.00
1976.4	3.04	2.21	4.04	2.38	1.14	0.60	0.59	0.17	0.10	0.07	0.09	0.00	0.00
1977.3	0.54	4.69	4.00	2.33	0.87	0.35	0.20	0.41	0.09	0.02	0.04	0.02	0.00
1978.2	0.61	1.18	3.22	0.50	0.34	0.21	0.21	0.17	0.16	0.04	0.00	0.00	0.00
1979.2	0.68	1.09	14.98	25.05	2.71	0.41	0.15	0.14	0.13	0.05	0.01	0.01	0.02
1980.2	5.53	1.44	1.07	3.88	2.87	0.55	0.50	0.19	0.16	0.11	0.06	0.03	0.00
1981.2	0.72	2.79	4.37	5.88	6.55	5.60	0.76	0.79	0.22	0.02	0.11	0.08	0.03
1982.4	2.24	0.97	4.77	1.63	0.88	1.31	1.49	0.47	0.12	0.06	0.03	0.01	0.01

Table 18. Cont'd.

Standardized Can RV Burgeo Residuals; MSE=0.97

Year	2	3	4	5	6	7	8	9	10	11	12
1993.3	0.00	-0.79	-0.71	-0.12	-0.21	-0.58	-0.23	-0.10	0.04	-0.31	-0.56
1994.3	0.00	-0.13	-0.13	-0.19	0.69	0.01	1.38	0.66	0.56	0.10	0.04
1995.3	0.00	-0.87	-0.68	-0.98	-1.00	-0.89	-0.42	-0.26	-0.28	-0.14	0.66
1996.3	0.55	0.64	0.24	-0.31	-0.52	-0.74	-0.65	-0.22	-0.88	0.43	-0.37
1997.3	-0.38	-0.63	-0.47	-1.01	-0.86	-1.08	-1.07	-0.60	-0.94	-0.77	-0.43
1998.3	-0.61	4.19	3.39	3.19	1.37	2.24	0.60	-0.51	-0.34	2.44	-0.62
1999.3	-0.57	-0.32	-0.08	0.63	-0.48	-0.49	-0.87	-0.72	-1.01	-0.52	1.18
2000.3	-0.93	-0.86	-0.05	-0.02	0.62	0.69	-0.20	0.17	-0.96	-1.14	0.29
2001.3	2.01	-0.52	-0.75	-0.50	-0.22	0.14	0.33	0.35	2.59	-0.62	-0.59
2002	-0.09	-0.68	-0.73	-0.67	0.63	0.73	1.20	1.47	1.86	0.66	0.18

Unstandardized Can RV Burgeo Residuals; MSE=27.74

Year	2	3	4	5	6	7	8	9	10	11	12
1993.3	0.00	-6.23	-11.20	-0.73	-1.47	-1.64	-0.15	-0.03	0.00	-0.08	-0.05
1994.3	0.00	-0.60	-1.12	-2.92	3.12	0.06	1.58	0.21	0.07	0.01	0.00
1995.3	0.00	-6.56	-3.46	-9.13	-13.60	-3.74	-1.12	-0.18	-0.04	-0.02	0.03
1996.3	0.45	3.64	2.06	-1.66	-4.33	-9.34	-1.43	-0.36	-0.29	0.06	-0.02
1997.3	-0.31	-3.14	-3.00	-8.90	-4.06	-8.15	-6.90	-0.77	-0.66	-0.22	-0.03
1998.3	-0.50	20.74	19.14	20.44	9.77	8.87	2.10	-1.78	-0.19	1.46	-0.07
1999.3	-1.05	-1.59	-0.47	3.49	-2.40	-2.65	-1.46	-1.22	-1.36	-0.23	0.22
2000.3	-2.52	-10.20	-0.31	-0.11	2.65	2.26	-0.39	0.13	-0.61	-1.19	0.04
2001.3	3.81	-9.03	-10.10	-2.86	-0.96	0.45	0.39	0.29	0.71	-0.30	-0.17
2002	-0.07	-8.38	-14.70	-9.46	3.03	2.63	1.57	0.80	0.62	0.14	0.03

Can RV Burgeo Index

Year	2	3	4	5	6	7	8	9	10	11	12
1993.3	0.00	3.37	8.04	6.44	6.94	1.73	0.53	0.21	0.09	0.15	0.00
1994.3	0.00	4.84	9.73	15.76	8.60	6.26	2.89	0.51	0.16	0.08	0.06
1995.3	0.49	2.60	2.75	2.26	3.03	1.32	2.07	0.58	0.08	0.06	0.05
1996.3	1.37	10.48	12.50	4.87	5.84	6.11	1.17	1.50	0.03	0.17	0.00
1997.3	0.60	2.94	4.73	1.83	1.66	1.02	0.92	0.72	0.11	0.05	0.00
1998.3	0.42	26.74	25.99	28.22	18.46	13.65	6.28	2.43	0.40	2.10	0.00
1999.3	1.14	4.50	6.24	10.27	3.61	3.90	0.50	0.76	0.20	0.23	0.38
2000.3	0.71	4.31	6.56	6.52	7.81	6.20	1.95	0.95	0.08	0.00	0.15
2001.3	6.05	12.35	6.32	4.07	4.35	4.20	1.73	1.22	0.96	0.21	0.10
2002	0.83	6.61	9.91	7.77	8.86	6.97	3.09	1.37	0.92	0.32	0.15

Standardized Can RV No Burgeo Residuals; MSE=1.07

Year	2	3	4	5	6	7	8	9	10	11	12	13	14
1983.3	0.00	-0.36	-1.13	-0.82	-0.79	-0.87	-0.53	0.75	0.69	1.09	1.62	0.05	0.76
1984.3	0.00	-1.02	-1.17	-1.33	-0.87	-0.93	-0.77	-0.78	0.66	-0.59	0.07	0.74	-0.34
1985.2	0.00	1.48	1.12	0.03	-0.26	-0.43	-0.87	-0.53	-0.67	0.17	0.61	0.96	1.28
1986.2	0.00	1.10	-0.41	-0.22	-0.37	-0.14	-0.60	-0.58	-0.46	-0.34	0.39	-0.06	-0.05
1987.2	0.00	0.50	1.26	2.08	1.24	0.44	0.16	-0.59	-0.53	-0.13	-0.23	0.74	0.58
1988.1	0.00	0.12	-0.62	-0.53	0.39	1.81	1.83	1.52	0.52	1.35	0.38	-0.30	0.63
1989.1	0.00	-0.52	-0.89	-1.15	-0.96	0.02	0.00	-0.33	0.37	0.30	-0.11	0.37	-0.41
1990.1	0.00	-0.24	1.53	0.90	1.05	2.06	1.78	-0.20	-0.06	0.32	-0.72	-0.44	-0.04
1991.1	0.00	0.77	-0.59	-0.07	0.38	1.01	2.09	0.56	2.90	1.28	1.59	0.16	0.39
1992.1	0.00	-0.14	-0.96	-1.09	-1.07	-0.67	-0.69	-0.74	-0.74	-0.82	-0.78	-0.59	-0.74
1993.1	0.00	0.00	-0.44	-0.62	-0.05	-0.64	-1.10	-0.97	-0.77	-1.12	-1.10	-0.76	-0.81
1993.3	-0.87	-0.57	-0.80	-0.55	-0.64	-0.81	-0.80	-0.48	-0.73	-0.60	-0.69	-0.26	-0.53
1994.3	0.00	-0.81	0.18	-0.36	-0.77	-0.57	-0.83	-0.88	-0.33	-0.40	-0.68	-0.49	-0.54
1995.3	0.00	-0.99	-0.28	6.16	6.18	2.56	2.58	5.34	1.79	2.49	-0.47	0.14	-0.31
1996.3	-0.26	-0.12	-0.35	-0.91	-0.49	-0.34	-0.89	-1.14	-0.55	0.11	-0.17	-0.25	-0.31
1997.3	1.31	-0.16	-1.06	-1.37	-1.32	-1.32	-1.41	-1.26	-1.19	-0.86	-0.57	-0.26	-0.17
1998.3	-0.44	-0.03	0.35	-0.26	-0.77	-0.45	0.73	0.39	-0.39	-0.93	-0.51	-0.31	-0.18
1999.3	-0.10	0.02	-0.53	0.02	0.36	0.03	-0.72	-0.32	-0.48	-0.90	-0.97	0.06	-0.21
2000.3	0.01	0.23	0.37	-0.75	-0.50	-0.45	-0.44	-0.50	-0.21	-0.05	-0.40	-0.67	-0.07
2001.3	-0.57	1.70	3.31	1.47	-0.18	-0.21	-0.02	0.21	-0.24	0.98	2.13	0.61	0.48
2002	0.08	-0.52	0.52	0.25	0.42	0.40	0.03	0.14	0.25	-0.72	-0.48	0.36	-0.02

Table 18. Cont'd.

Unstandardized Can RV No Burgeo Residuals; MSE=4.11

Year	2	3	4	5	6	7	8	9	10	11	12	13	14
1983.3	0.00	-2.05	-3.49	-3.93	-1.59	-0.73	-0.56	0.63	0.29	0.22	0.11	0.00	0.04
1984.3	0.00	-5.40	-5.70	-4.22	-2.83	-1.00	-0.52	-0.59	0.27	-0.18	0.01	0.04	-0.03
1985.2	0.00	6.89	5.17	0.16	-0.62	-0.75	-0.76	-0.26	-0.26	0.05	0.14	0.11	0.06
1986.2	0.00	2.46	-1.62	-1.07	-1.30	-0.16	-0.70	-0.32	-0.11	-0.09	0.08	-0.01	-0.01
1987.2	0.00	1.51	2.38	7.83	3.79	0.65	0.12	-0.41	-0.15	-0.02	-0.05	0.11	0.08
1988.1	0.00	0.47	-1.60	-1.00	0.90	2.46	1.72	0.68	0.18	0.26	0.05	-0.04	0.08
1989.1	0.00	-2.26	-2.96	-2.71	-1.07	0.02	0.00	-0.18	0.08	0.07	-0.02	0.04	-0.05
1990.1	0.00	-0.99	5.56	2.54	1.28	1.08	1.29	-0.10	-0.02	0.05	-0.13	-0.05	0.00
1991.1	0.00	1.52	-1.97	-0.23	0.59	0.54	0.71	0.25	0.70	0.24	0.18	0.02	0.04
1992.1	0.00	-0.56	-1.56	-3.23	-1.79	-0.36	-0.19	-0.14	-0.16	-0.13	-0.11	-0.05	-0.08
1993.1	0.00	0.00	-0.95	-1.28	-0.15	-2.00	-1.58	-1.29	-1.31	-1.73	-0.64	-0.40	-0.22
1993.3	-0.22	-0.09	-0.12	-0.05	-0.06	-0.12	-0.12	-0.05	-0.08	-0.06	-0.07	-0.02	-0.04
1994.3	0.00	-0.98	0.33	-1.20	-0.60	-0.51	-0.35	-0.15	-0.03	-0.03	-0.08	-0.04	-0.05
1995.3	0.00	-1.95	-0.29	12.65	18.40	1.92	2.34	1.86	0.20	0.19	-0.03	0.01	-0.02
1996.3	-0.22	-0.19	-0.61	-1.10	-0.90	-0.72	-0.67	-0.85	-0.12	0.01	-0.01	-0.01	-0.01
1997.3	1.13	-0.21	-1.37	-2.66	-1.42	-1.70	-2.97	-0.77	-0.51	-0.14	-0.04	-0.01	0.00
1998.3	-0.38	-0.04	0.40	-0.37	-1.22	-0.32	0.85	0.62	-0.13	-0.29	-0.07	-0.01	0.00
1999.3	-0.19	0.03	-0.60	0.02	0.41	0.03	-0.42	-0.26	-0.38	-0.22	-0.23	0.00	-0.01
2000.3	0.03	0.70	0.43	-0.93	-0.49	-0.27	-0.30	-0.19	-0.08	-0.02	-0.07	-0.06	0.00
2001.3	-1.15	7.61	8.81	1.88	-0.18	-0.12	-0.01	0.09	-0.04	0.25	0.77	0.05	0.03
2002	0.07	-1.66	2.05	0.76	0.46	0.26	0.01	0.04	0.05	-0.09	-0.09	0.05	0.00

Can RV No Burgeo Index

Year	2	3	4	5	6	7	8	9	10	11	12	13	14
1983.3	11.41	6.63	1.08	3.24	1.36	0.42	0.93	1.78	0.82	0.42	0.15	0.06	0.07
1984.3	5.77	2.53	1.59	0.50	2.00	0.52	0.38	0.43	0.78	0.17	0.15	0.06	0.02
1985.2	7.50	13.83	12.11	7.93	2.89	1.76	0.45	0.37	0.22	0.38	0.39	0.20	0.08
1986.2	5.76	5.79	4.25	6.18	3.93	1.48	0.95	0.40	0.15	0.20	0.29	0.14	0.07
1987.2	9.46	5.94	5.14	13.45	8.32	2.74	1.08	0.53	0.16	0.14	0.15	0.23	0.21
1988.1	10.13	6.44	2.20	1.75	4.31	4.41	3.02	1.24	0.57	0.45	0.16	0.08	0.18
1989.1	6.76	4.24	1.98	0.74	0.51	1.45	1.07	0.54	0.30	0.32	0.11	0.10	0.05
1990.1	1.51	5.14	10.97	6.71	3.02	1.75	2.26	0.55	0.29	0.18	0.04	0.03	0.05
1991.1	30.70	4.40	3.01	4.50	2.62	1.24	1.11	0.80	0.96	0.42	0.26	0.12	0.10
1992.1	1.92	5.32	0.79	1.14	0.62	0.33	0.12	0.04	0.06	0.01	0.01	0.00	0.00
1993.1	0.00	0.00	2.19	1.73	4.75	2.60	0.48	0.60	1.16	0.49	0.12	0.28	0.08
1993.3	0.05	0.05	0.01	0.01	0.00	0.01	0.01	0.03	0.00	0.01	0.00	0.02	0.00
1994.3	1.81	0.73	2.92	3.72	0.65	0.73	0.17	0.01	0.03	0.01	0.01	0.01	0.01
1995.3	0.24	0.92	1.19	15.65	22.81	2.93	3.60	2.27	0.29	0.23	0.00	0.07	0.02
1996.3	0.98	1.96	1.89	0.62	1.79	2.38	0.35	0.16	0.10	0.07	0.02	0.00	0.00
1997.3	2.32	1.70	0.48	0.17	0.09	0.14	0.11	0.04	0.02	0.01	0.00	0.00	0.00
1998.3	0.82	1.84	2.04	1.68	1.08	0.64	2.50	2.91	0.27	0.07	0.04	0.00	0.00
1999.3	2.68	1.94	1.00	1.81	2.00	1.34	0.35	0.83	0.69	0.04	0.02	0.03	0.00
2000.3	4.25	5.26	2.07	0.82	0.88	0.52	0.62	0.26	0.39	0.64	0.10	0.00	0.01
2001.3	1.78	14.31	12.75	3.71	1.23	0.63	0.52	0.59	0.13	0.54	1.21	0.09	0.06
2002	1.25	3.04	7.93	5.30	2.00	1.13	0.61	0.35	0.26	0.01	0.10	0.16	0.02

Standardized Sentinel Gillnet Residuals; MSE=0.72

Year	3	4	5	6	7	8	9	10
1995.5	0.32	0.17	1.14	0.10	1.55	0.53	0.32	1.10
1996.5	0.51	0.95	0.99	1.74	0.15	1.02	0.21	-0.60
1997.5	0.15	1.33	1.81	0.96	1.01	0.82	0.95	1.38
1998.5	-0.23	-0.56	-0.62	0.44	0.14	-0.30	-0.22	0.27
1999.5	-0.37	-0.91	-0.69	-0.91	-0.69	-0.64	-1.02	-1.00
2000.5	-0.26	-0.70	-1.28	-1.20	-1.09	-0.59	-0.04	-0.88
2001.5	-0.06	-0.37	-1.20	-1.15	-1.10	-0.90	-0.14	0.16

Table 18. Cont'd.

Unstandardized Sentinel Gillnet Residuals; MSE=1.64

Year	3	4	5	6	7	8	9	10
1995.5	0.01	0.01	1.80	0.53	2.60	0.64	0.06	0.07
1996.5	0.01	0.11	0.92	5.61	0.74	1.01	0.09	-0.07
1997.5	0.00	0.13	2.66	1.74	3.01	2.35	0.34	0.32
1998.5	0.00	-0.05	-0.88	1.18	0.22	-0.46	-0.21	0.05
1999.5	-0.01	-0.08	-0.64	-1.65	-1.40	-0.45	-0.46	-0.42
2000.5	-0.01	-0.06	-1.18	-1.91	-1.32	-0.49	-0.01	-0.18
2001.5	0.00	-0.06	-1.16	-1.91	-1.31	-0.45	-0.03	0.02

Sentinel gillnet index

Year	3	4	5	6	7	8	9	10
1995.5	0.02	0.09	4.31	9.07	5.29	2.55	0.33	0.12
1996.5	0.02	0.25	2.36	10.83	8.93	2.57	0.74	0.06
1997.5	0.01	0.22	4.99	4.63	7.78	6.97	0.85	0.63
1998.5	0.00	0.04	0.81	5.51	2.67	1.95	1.23	0.28
1999.5	0.00	0.01	0.81	1.25	1.84	0.64	0.21	0.20
2000.5	0.01	0.03	0.26	0.62	0.60	0.80	0.26	0.09
2001.5	0.03	0.15	0.35	0.72	0.56	0.29	0.27	0.11

Standardized Sentinel Linetrawl Residuals; MSE=0.86

Year	3	4	5	6	7	8	9
1995.5	-0.38	-0.20	1.25	1.36	2.12	0.97	0.41
1996.5	0.11	-0.19	0.56	1.12	1.20	1.21	0.85
1997.5	-0.21	0.21	-1.38	-0.61	-0.94	-0.66	-1.15
1998.5	0.78	-0.06	-0.69	-1.30	-0.96	-0.96	0.26
1999.5	1.06	-0.12	-0.10	-0.32	-1.34	-0.10	-0.37
2000.5	-0.06	2.34	1.19	0.77	0.41	0.12	0.39
2001.5	-0.89	-1.72	-0.81	-1.30	-0.64	-0.40	-0.43

Table 18. Cont'd.

Unstandardized Sentinel Gillnet Residuals; MSE=1.64

Year	3	4	5	6	7	8	9	10
1995.5	0.01	0.01	1.80	0.53	2.60	0.64	0.06	0.07
1996.5	0.01	0.11	0.92	5.61	0.74	1.01	0.09	-0.07
1997.5	0.00	0.13	2.66	1.74	3.01	2.35	0.34	0.32
1998.5	0.00	-0.05	-0.88	1.18	0.22	-0.46	-0.21	0.05
1999.5	-0.01	-0.08	-0.64	-1.65	-1.40	-0.46	-0.46	-0.42
2000.5	-0.01	-0.06	-1.18	-1.91	-1.32	-0.49	-0.01	-0.18
2001.5	0.00	-0.06	-1.16	-1.91	-1.31	-0.45	-0.03	0.02

Sentinel gillnet index

Year	3	4	5	6	7	8	9	10
1995.5	0.02	0.09	4.31	9.07	5.29	2.55	0.33	0.12
1996.5	0.02	0.25	2.36	10.83	8.93	2.57	0.74	0.06
1997.5	0.01	0.22	4.99	4.63	7.78	6.97	0.85	0.63
1998.5	0.00	0.04	0.81	5.51	2.67	1.95	1.23	0.28
1999.5	0.00	0.01	0.81	1.25	1.84	0.64	0.21	0.20
2000.5	0.01	0.03	0.26	0.62	0.60	0.80	0.26	0.09
2001.5	0.03	0.15	0.35	0.72	0.56	0.29	0.27	0.11

Standardized Sentinel Linetrawl Residuals; MSE=0.86

Year	3	4	5	6	7	8	9
1995.5	-0.38	-0.20	1.25	1.36	2.12	0.97	0.41
1996.5	0.11	-0.19	0.56	1.12	1.20	1.21	0.85
1997.5	-0.21	0.21	-1.38	-0.61	-0.94	-0.66	-1.15
1998.5	0.78	-0.06	-0.69	-1.30	-0.96	-0.96	0.26
1999.5	1.06	-0.12	-0.10	-0.32	-1.34	-0.10	-0.37
2000.5	-0.06	2.34	1.19	0.77	0.41	0.12	0.39
2001.5	-0.89	-1.72	-0.81	-1.30	-0.64	-0.40	-0.43

Unstandardized Sentinel Linetrawl Residuals; MSE=0.00

Year	3	4	5	6	7	8	9
1995.5	0.00	0.00	0.02	0.02	0.01	0.00	0.00
1996.5	0.00	0.00	0.00	0.01	0.01	0.00	0.00
1997.5	0.00	0.00	-0.02	0.00	-0.01	-0.01	0.00
1998.5	0.00	0.00	-0.01	-0.01	0.00	-0.01	0.00
1999.5	0.00	0.00	0.00	0.00	-0.01	0.00	0.00
2000.5	0.00	0.02	0.01	0.00	0.00	0.00	0.00
2001.5	-0.01	-0.03	-0.01	-0.01	0.00	0.00	0.00

Sentinel Linetrawl Index

Year	3	4	5	6	7	8	9
1995.5	0.01	0.02	0.06	0.09	0.02	0.02	0.00
1996.5	0.01	0.03	0.03	0.05	0.05	0.02	0.01
1997.5	0.01	0.03	0.03	0.02	0.02	0.03	0.00
1998.5	0.01	0.02	0.03	0.02	0.01	0.01	0.01
1999.5	0.01	0.02	0.03	0.02	0.01	0.01	0.01
2000.5	0.02	0.04	0.04	0.02	0.01	0.01	0.00
2001.5	0.02	0.03	0.02	0.01	0.01	0.00	0.00

Table 19. Inputs and structure for the projection of spawner biomass from 1 April 2002 to 1 April 2004.

Proportion of TAC or F

Year	Period From	To	Prop
2002	1-Apr	31-Dec	0.83
2003	1-Jan	31-Mar	0.17
2003	1-Apr	31-Dec	0.83
2004	1-Jan	31-Mar	0.17
2004	1-Apr	31-Dec	0.83
2005	1-Jan	31-Mar	0.17

Partial Recruitment

To be computed from the average of the PR for the period 1999-2001 from the relevant SPA
Method is to calculated the PR in each year, take the average, and then rescale the vector to have a maximum of 1

Recruitment at age 3

Geometric mean of numbers at age 3 in 2000-2002 from the relevant SPA
Alternative - Geometric mean of numbers at age 3 for the period 1993-2002

Natural mortality

M = 0.2

Population weight at age (Jan 1)

	2	3	4	5	6	7	8	9	10	11	12	13	14
2002	0.000	0.553	0.846	1.285	1.730	2.154	2.806	3.716	3.499	3.848	6.134	9.259	8.321
2003	0.000	0.553	0.833	1.275	1.900	2.278	2.607	3.351	4.445	4.251	4.661	7.238	11.434
2004	0.000	0.529	0.782	1.168	1.726	2.299	2.797	3.257	3.868	4.769	5.679	6.203	7.774
2005	0.000	0.529	0.782	1.168	1.726	2.299	2.797	3.257	3.868	4.769	5.679	6.203	7.774

Catch weights at age (midyear)(see section 3.1)

	2	3	4	5	6	7	8	9	10	11	12	13	14
2002	0.000	0.668	1.039	1.621	2.078	2.397	3.058	4.054	3.820	4.286	6.726	9.960	9.099
2003	0.000	0.648	0.951	1.448	2.047	2.555	3.076	3.558	4.205	5.266	6.315	7.028	8.708
2004	0.000	0.648	0.951	1.448	2.047	2.555	3.076	3.558	4.205	5.266	6.315	7.028	8.708
2005	0.000	0.648	0.951	1.448	2.047	2.555	3.076	3.558	4.205	5.266	6.315	7.028	8.708

Maturity at age (from Table 17)

	2	3	4	5	6	7	8	9	10	11	12	13	14
2002	0.003	0.014	0.086	0.560	0.724	0.886	0.984	0.999	1.000	1.000	1.000	1.000	1.000
2003	0.003	0.014	0.086	0.381	0.927	0.941	0.972	0.996	1.000	1.000	1.000	1.000	1.000
2004	0.003	0.014	0.086	0.381	0.762	0.992	0.990	0.994	0.999	1.000	1.000	1.000	1.000
2005	0.003	0.014	0.086	0.381	0.762	0.940	0.999	0.998	0.999	1.000	1.000	1.000	1.000

Table 20. Comparison of results from 3-year deterministic projections at fixed annual TAC options ranging from 10,000 to 20,000 t . Results are given in terms of percent change in Spawning stock biomass (SSB) for each of the five SPA model/formulations considered.

Model/ formulation	Percent change in SSB from 2002 to 2005 at fixed TAC (t) of :		
	10,000	15,000	20,000
A	20.05	14.23	7.53
B	21.57	17.84	13.75
C	48.05	43.66	38.47
D	41.23	36.45	30.81
E	25.79	19.16	11.41

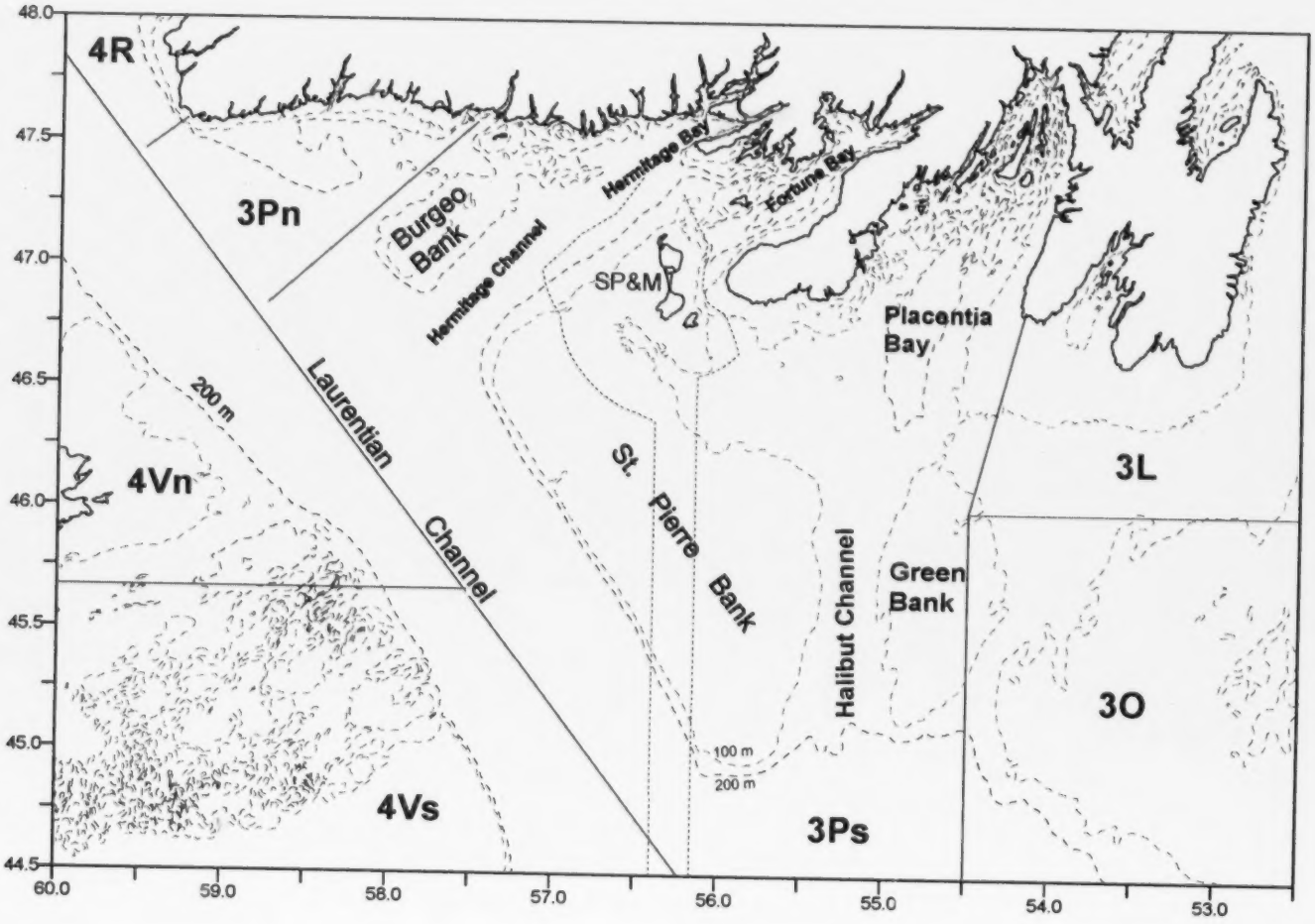

Fig. 1. NAFO Subdivision 3Ps management unit, boundaries of French economic zone (fine dashed line) and main fishing areas.

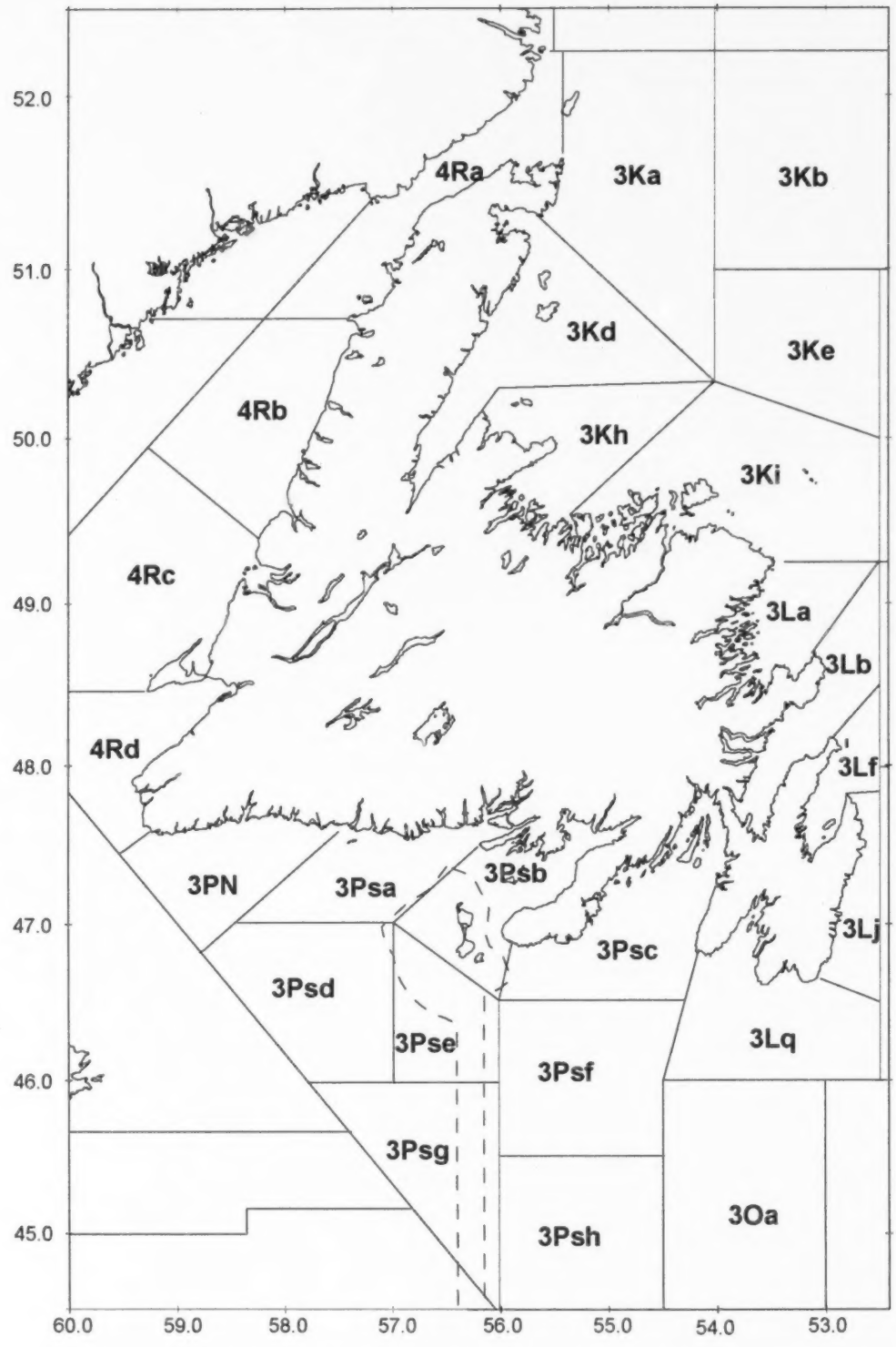

Fig. 2. Names and boundaries of NAFO statistical areas around insular Newfoundland. The dashed line indicates the boundary of the French economic zone.

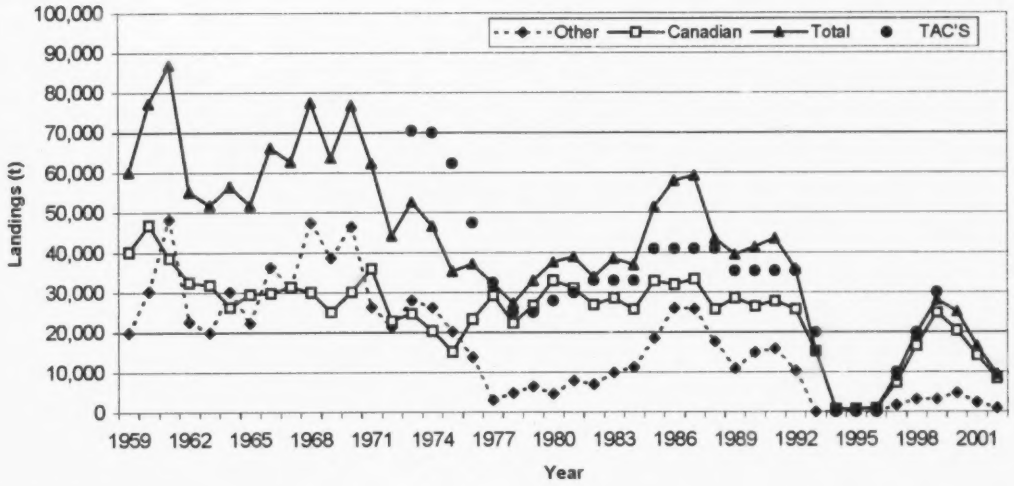

Fig. 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps during 1959 to 1 Oct 2002.

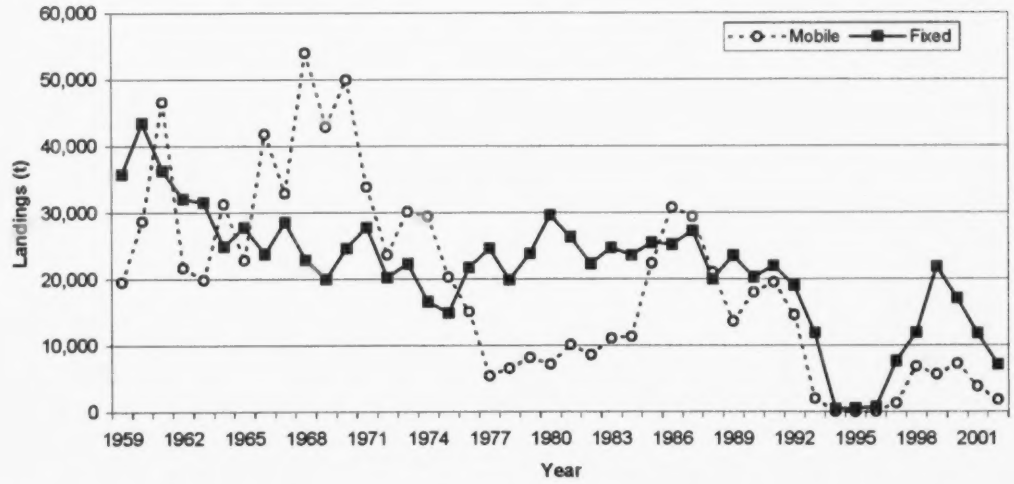

Fig. 3b. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps during 1959 to 1 Oct 2002.

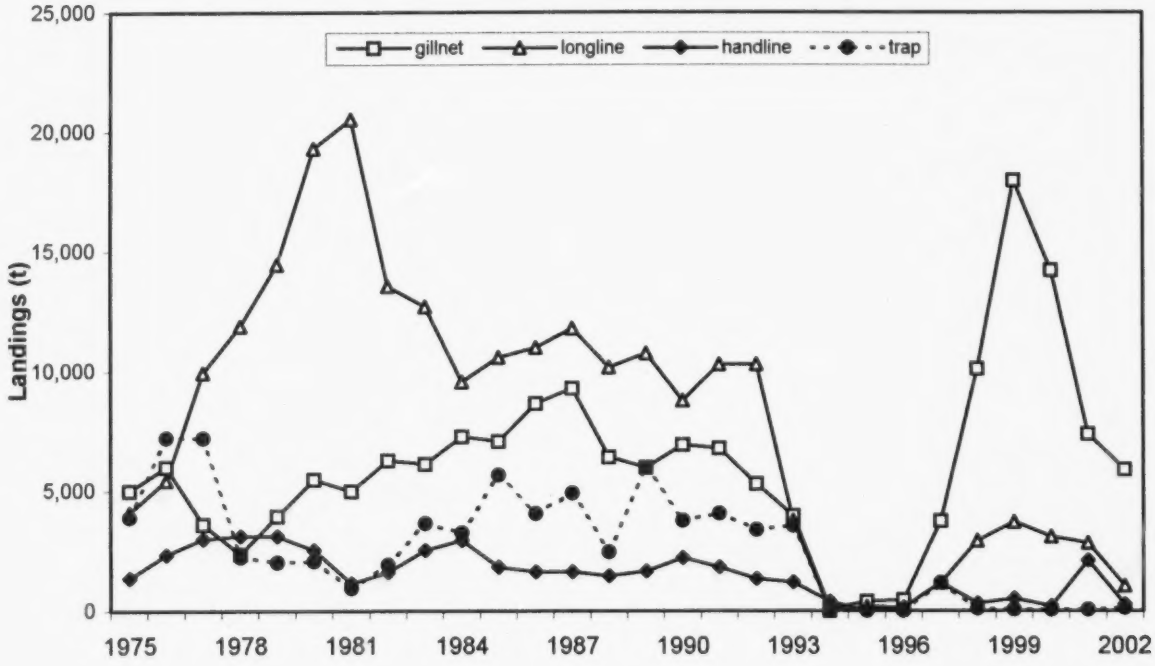

Fig. 4. Reported landings of cod by various fixed gears in NAFO Subdiv. 3Ps during 1975 to Oct 2002.

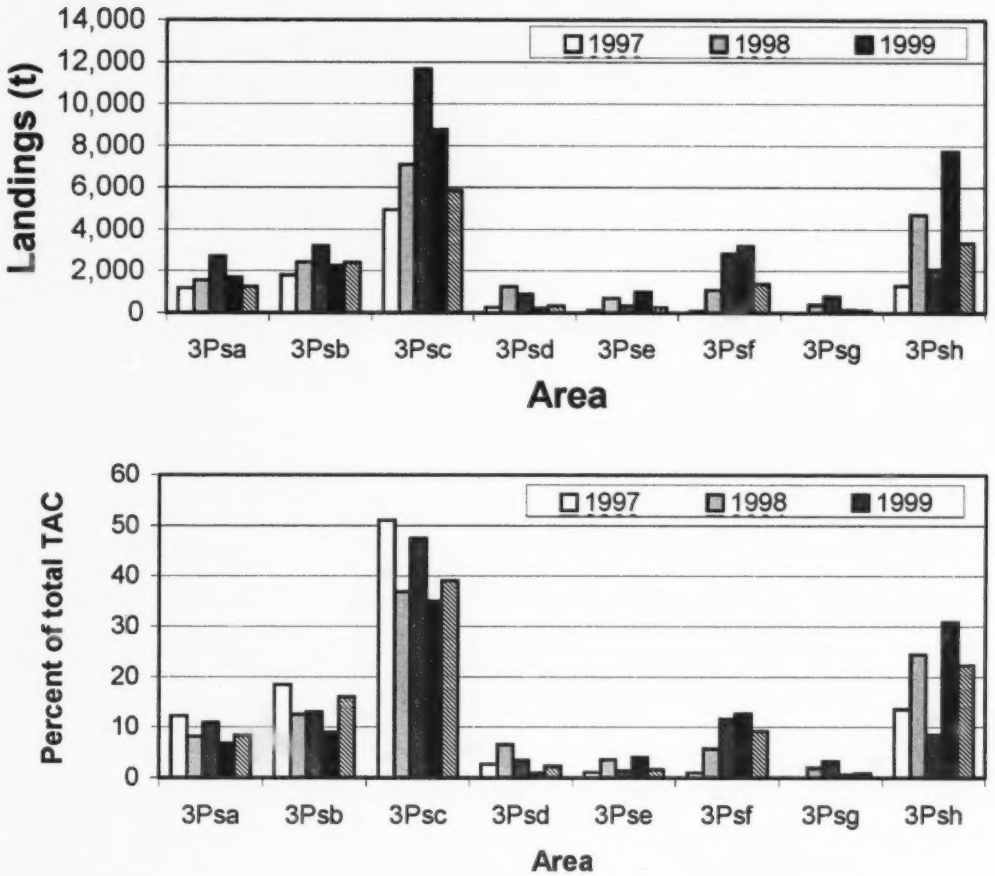

Fig. 5. Annual reported landings of cod by unit area from NAFO Subdiv. 3Ps during 1997-2001.

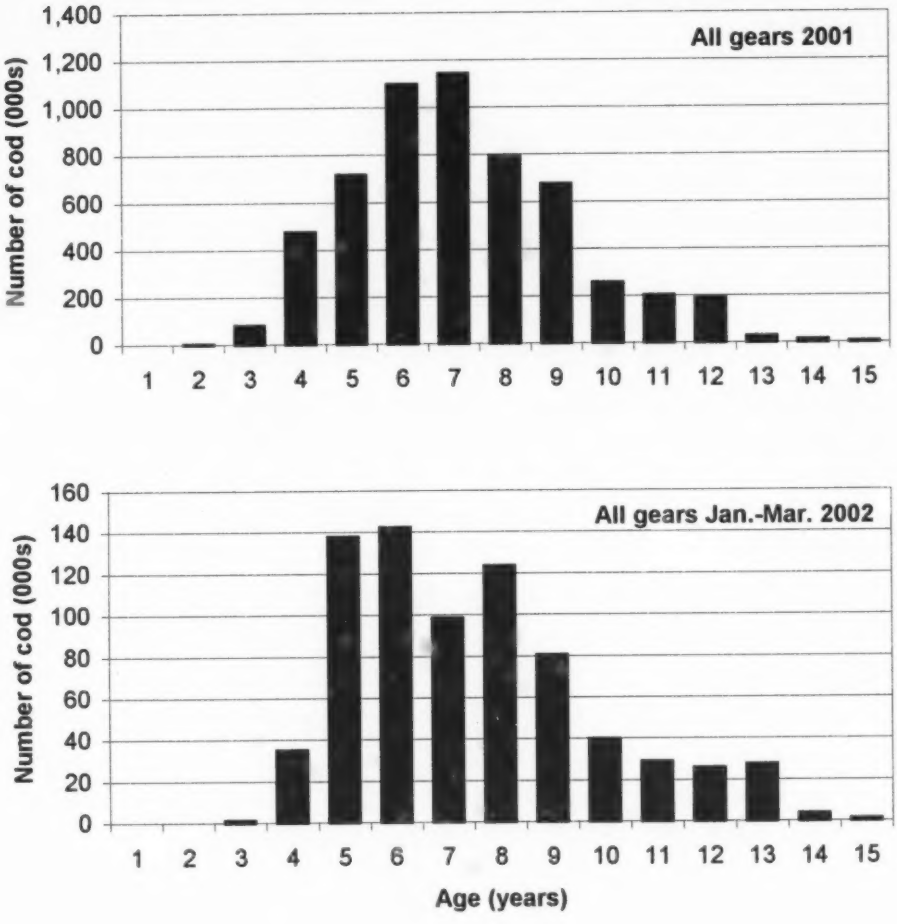

Fig. 6. Catch numbers-at-age for the commercial fishery in NAFO Subdiv. 3Ps during 2001 and during January-March 2002.

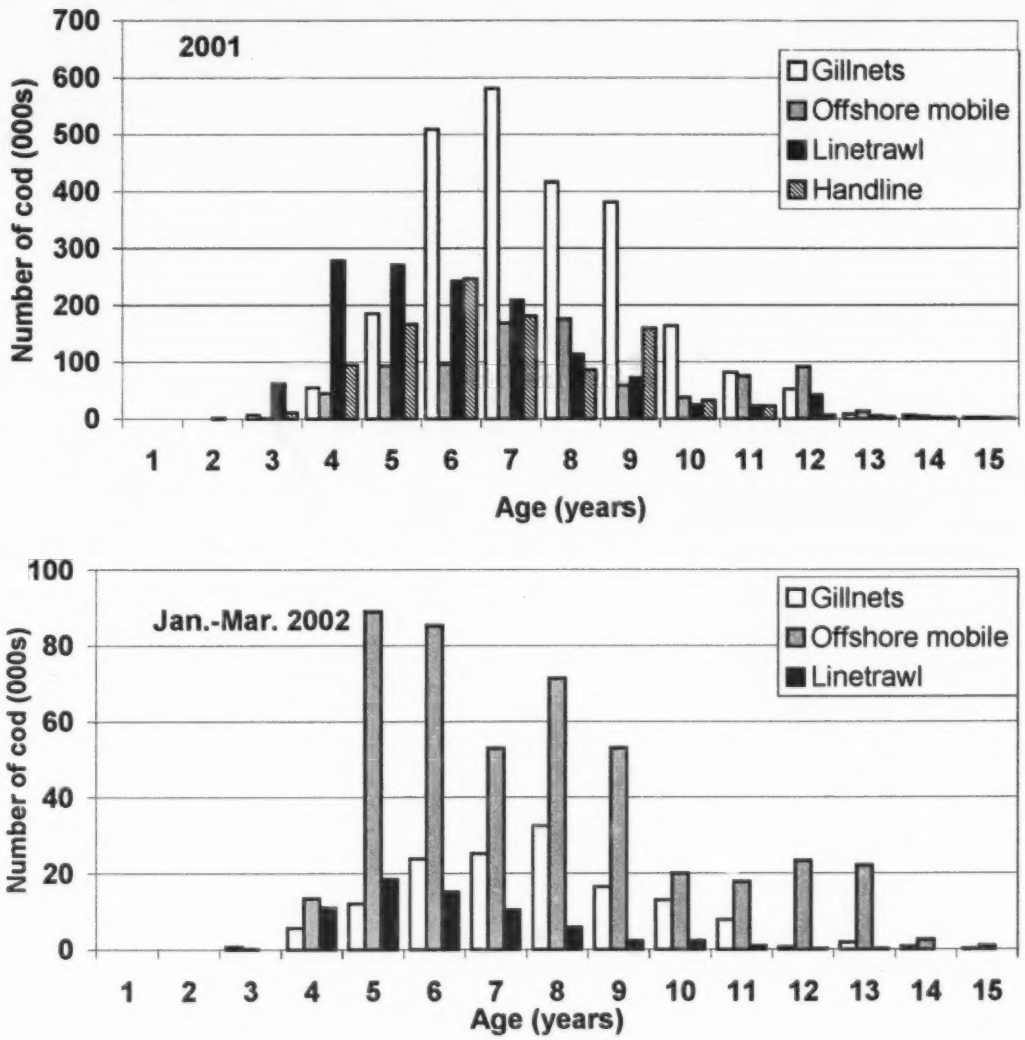

Fig. 7. Catch-at-age (000's) for the main gear types used in the cod fishery in NAFO Subdiv. 3Ps du 2002. Offshore mobile gear is otter trawl and Norwegian seine.

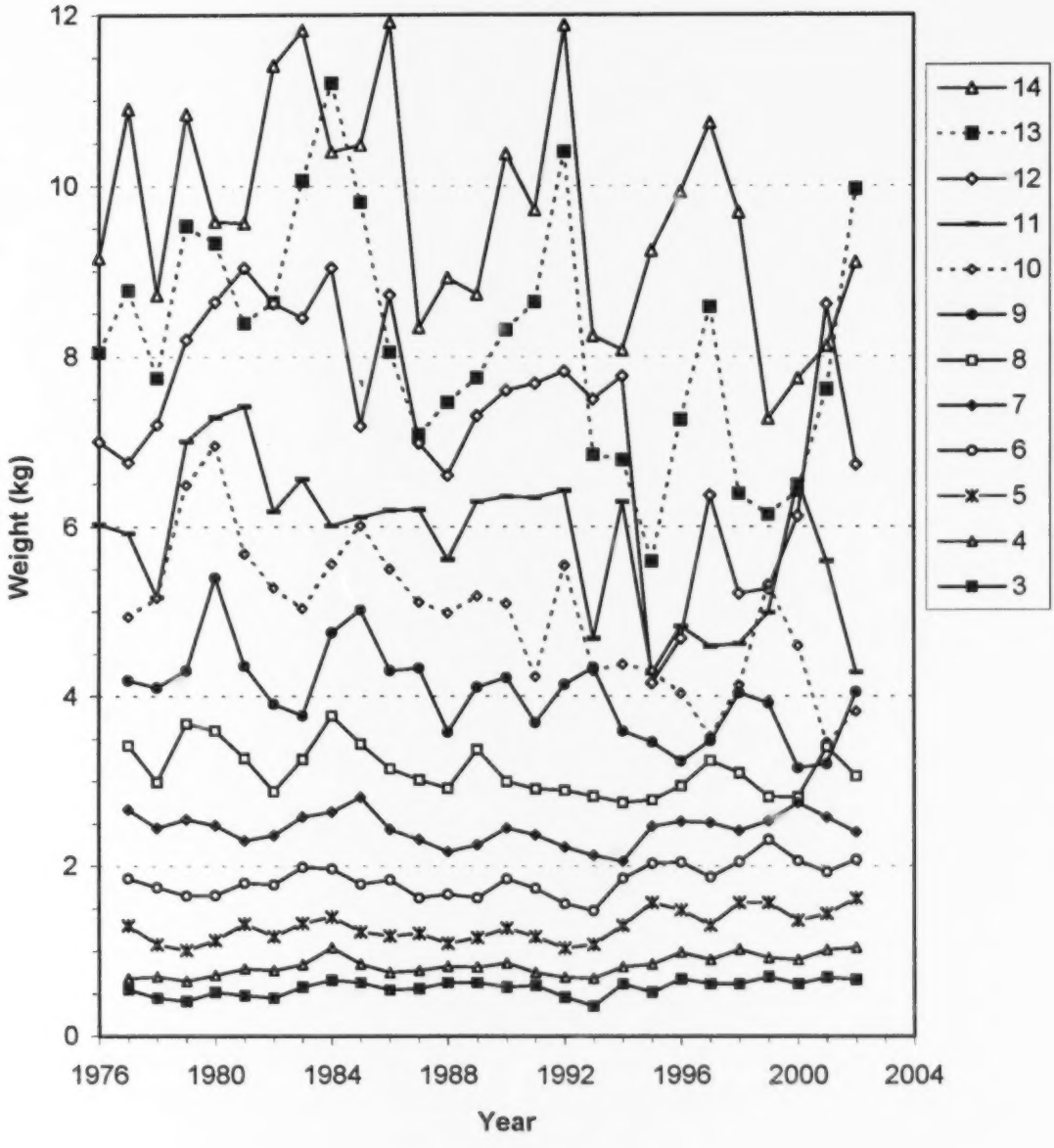

Fig. 8a. Mean weights-at-age (3-10) calculated from mean lengths-at-age for the commercial catch of cod from NAFO Subdiv. 3Ps. during 1976-2002.

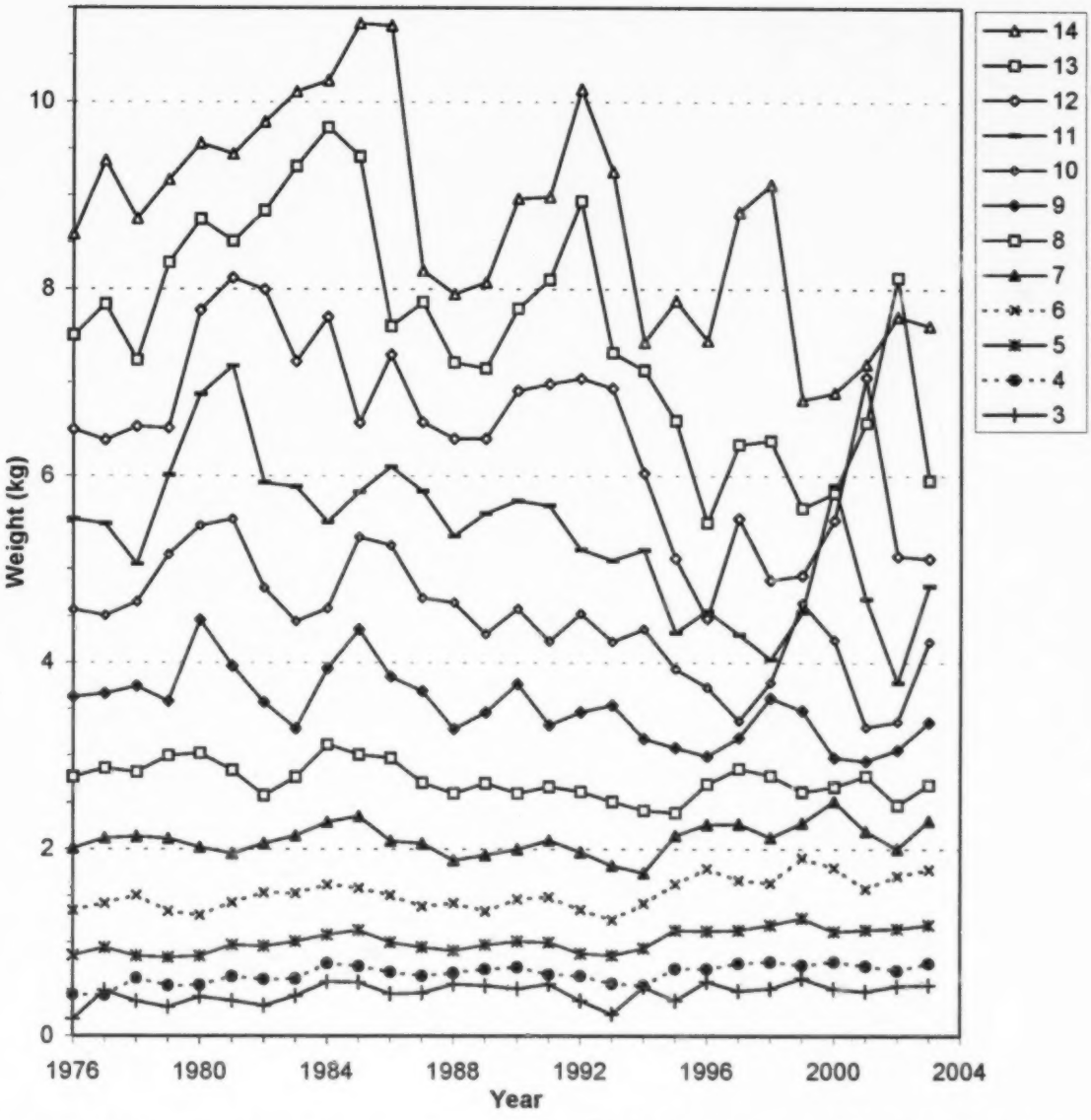

Fig. 8b. Beginning of year mean weights-at-age (3-14) from the commercial catch of cod in NAFO Subdiv. 3Ps during 1976-2002. The values for 2003 are extrapolated as described in the text.

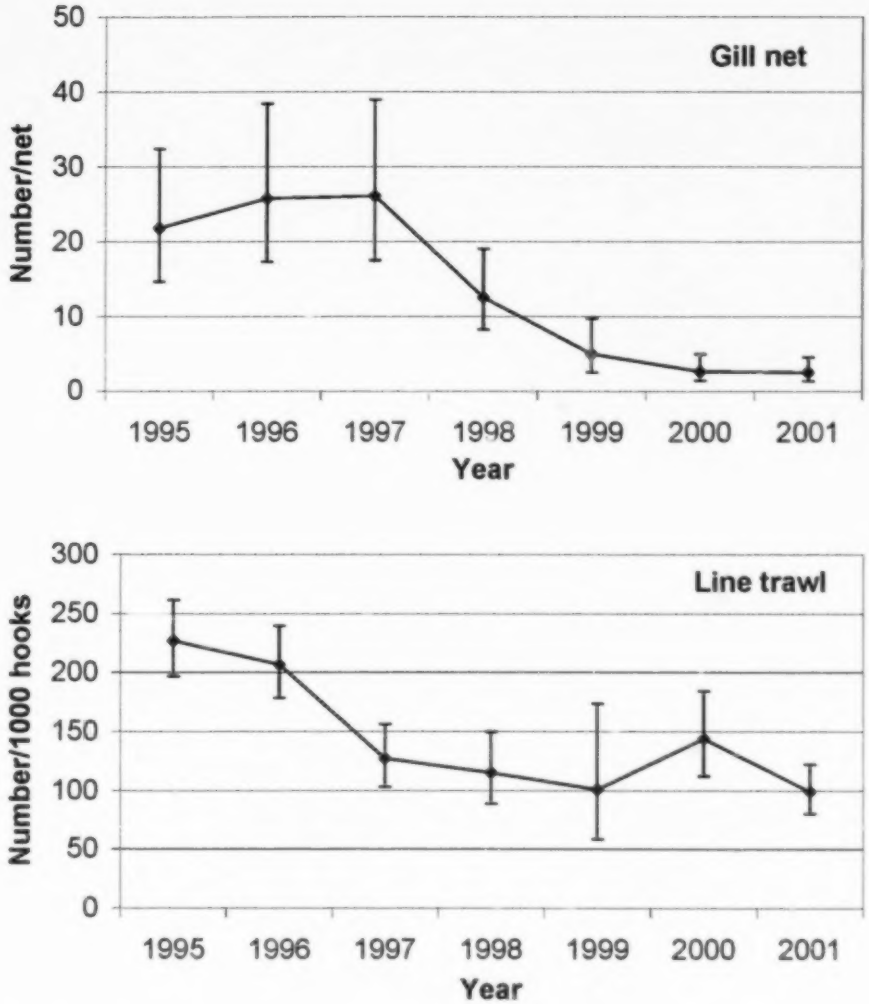

Fig. 9. Standardized total annual catch rate indices for gill nets (5.5" mesh) and line-trawls (with 95% CL's) estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gill nets and fish per 1000 hooks for line trawl.

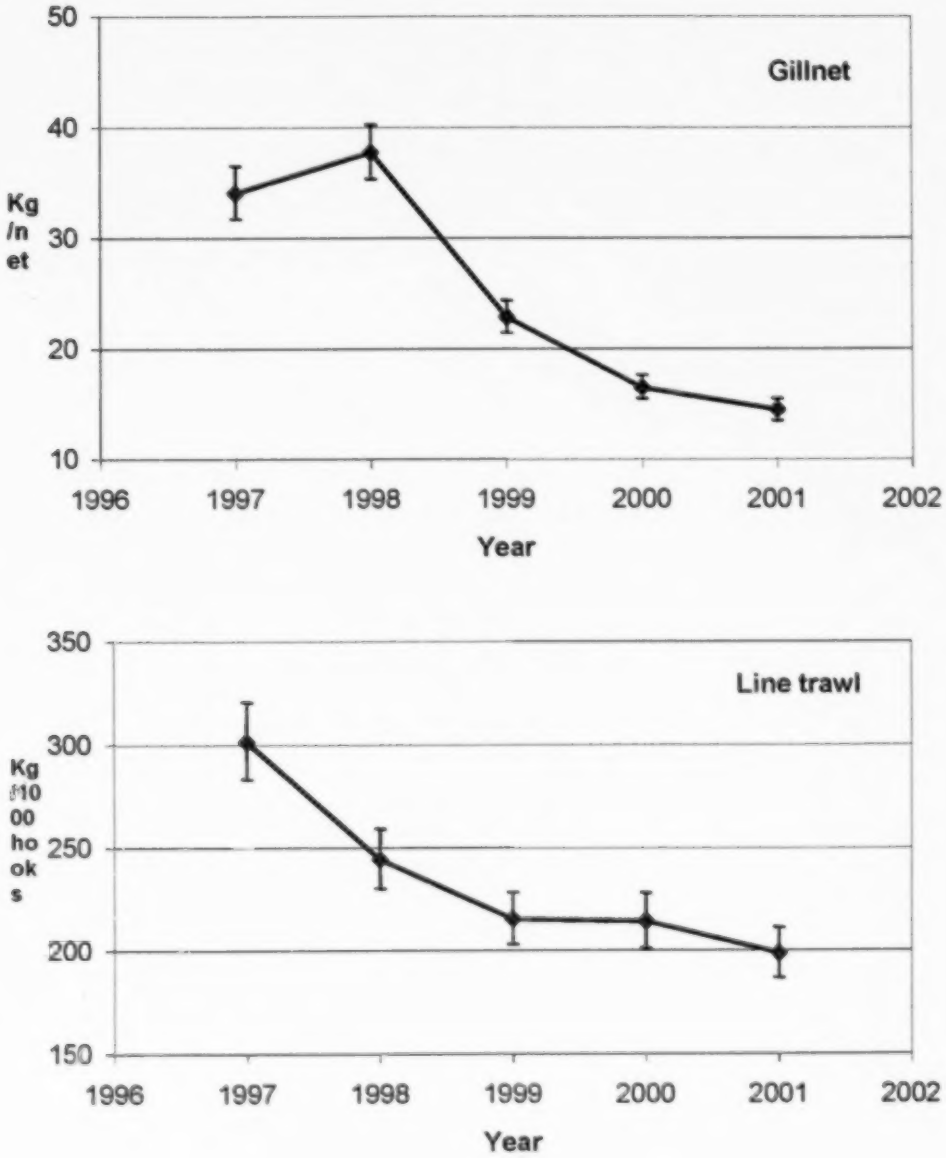

Fig. 10a. Standardized total annual catch rate indices (with 95% CL's) for gillnets and line-trawls using data from science logbooks for the <35ft sector. Catch rate are expressed as kg per net for gillnets and kg per 1000 hooks for line-trawl. Catch is live weight equivalence (kg).

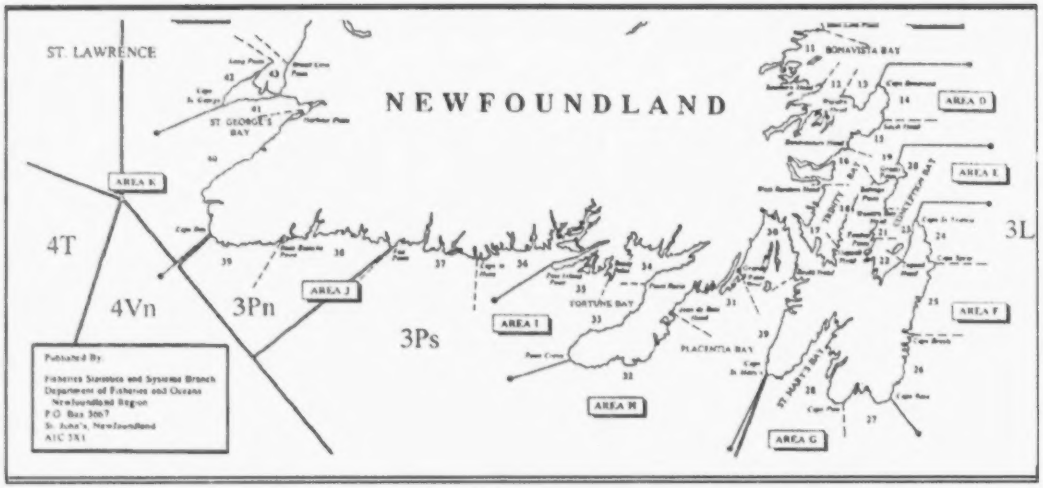

Fig. 10b. Southern Newfoundland showing NAFO Subdivision 3Ps, boundaries of management areas H, I, J (solid lines with terminal dot), and boundaries of lobster management areas numbered 29-37 (dashed lines).

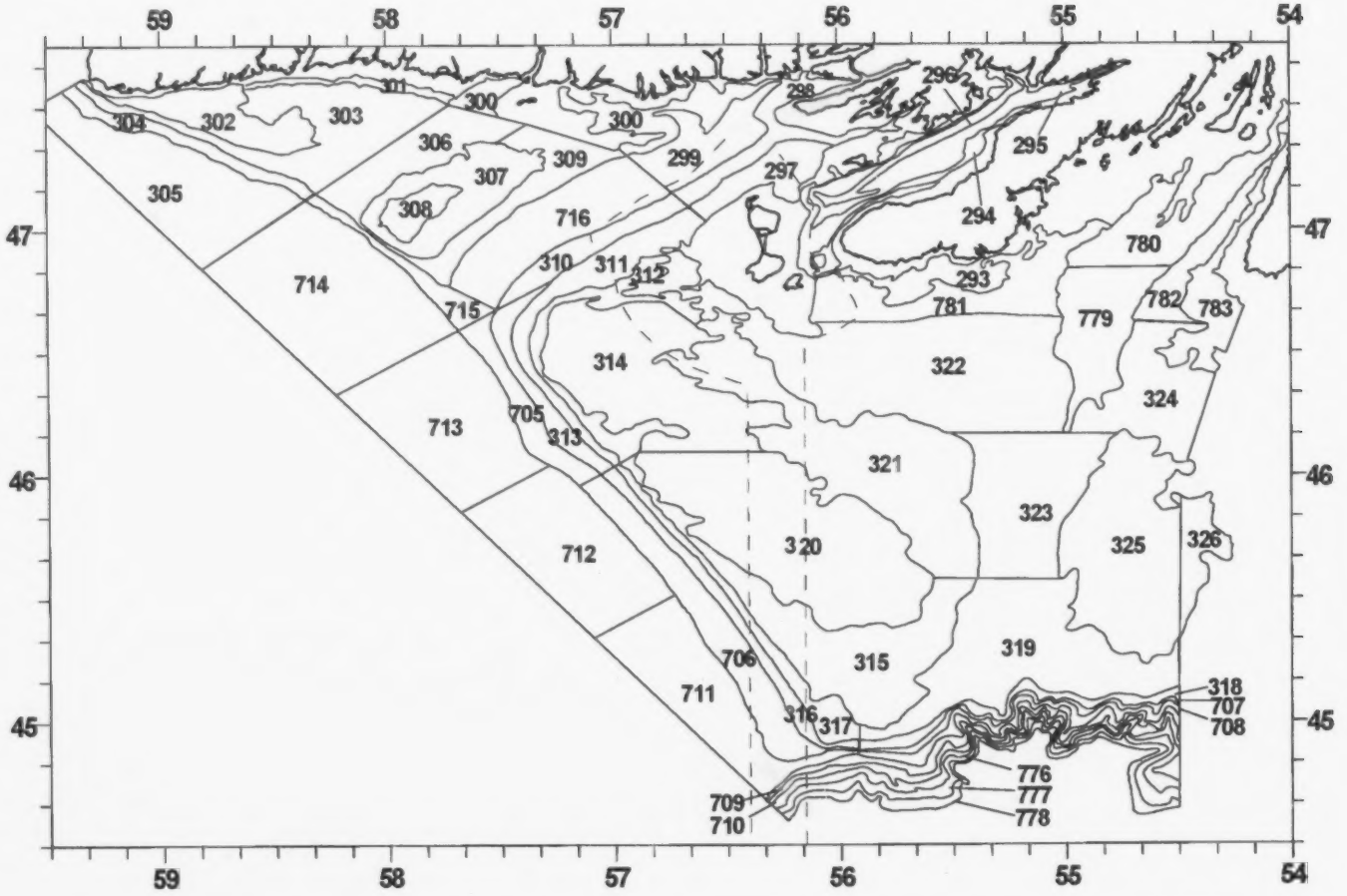

Fig. 11. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps (revised March 1999).

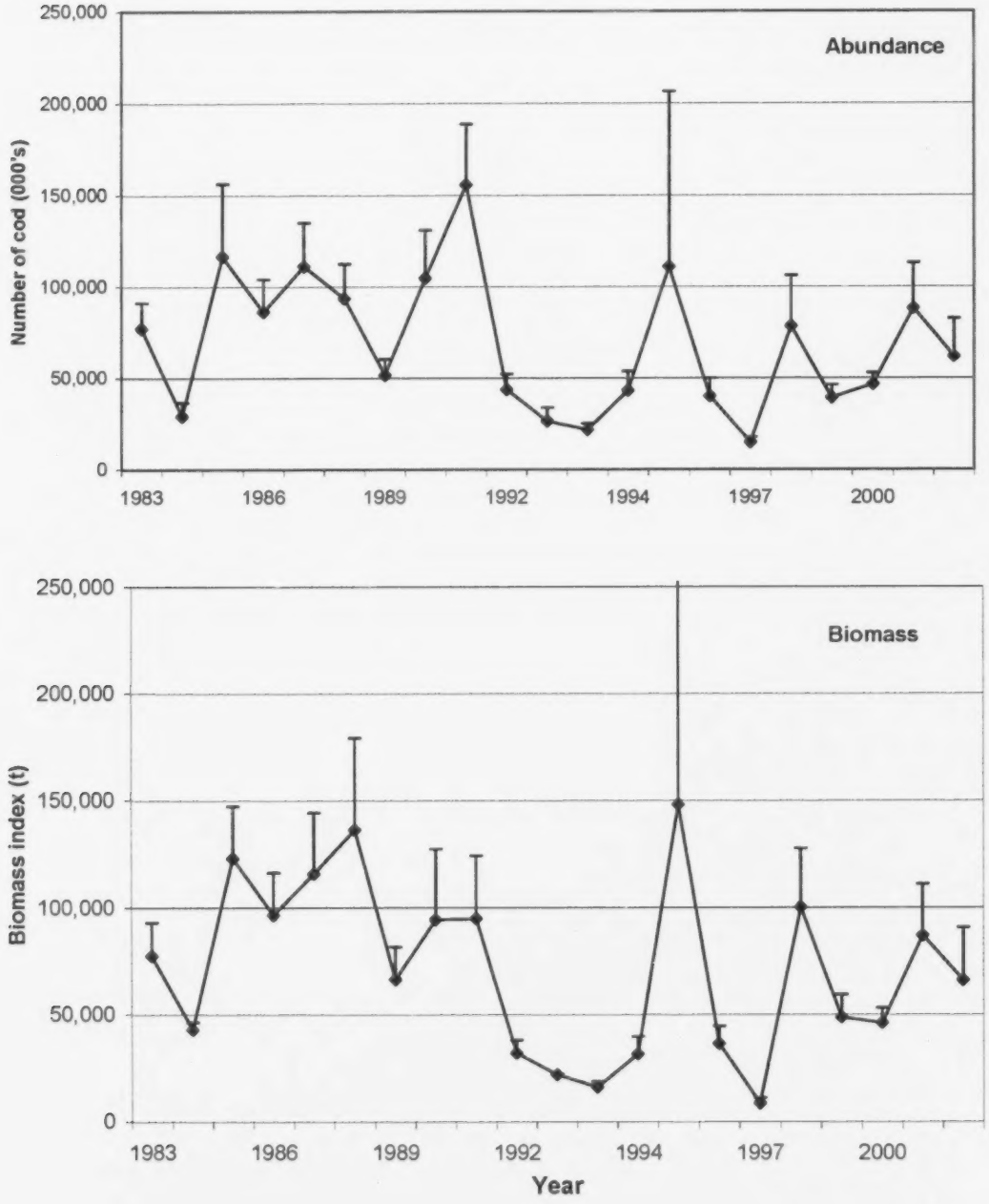

Fig. 12. Abundance and biomass indices for cod in NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys during winter/spring from 1983/2002. There were two surveys in 1993. Error bars show plus one standard deviation.

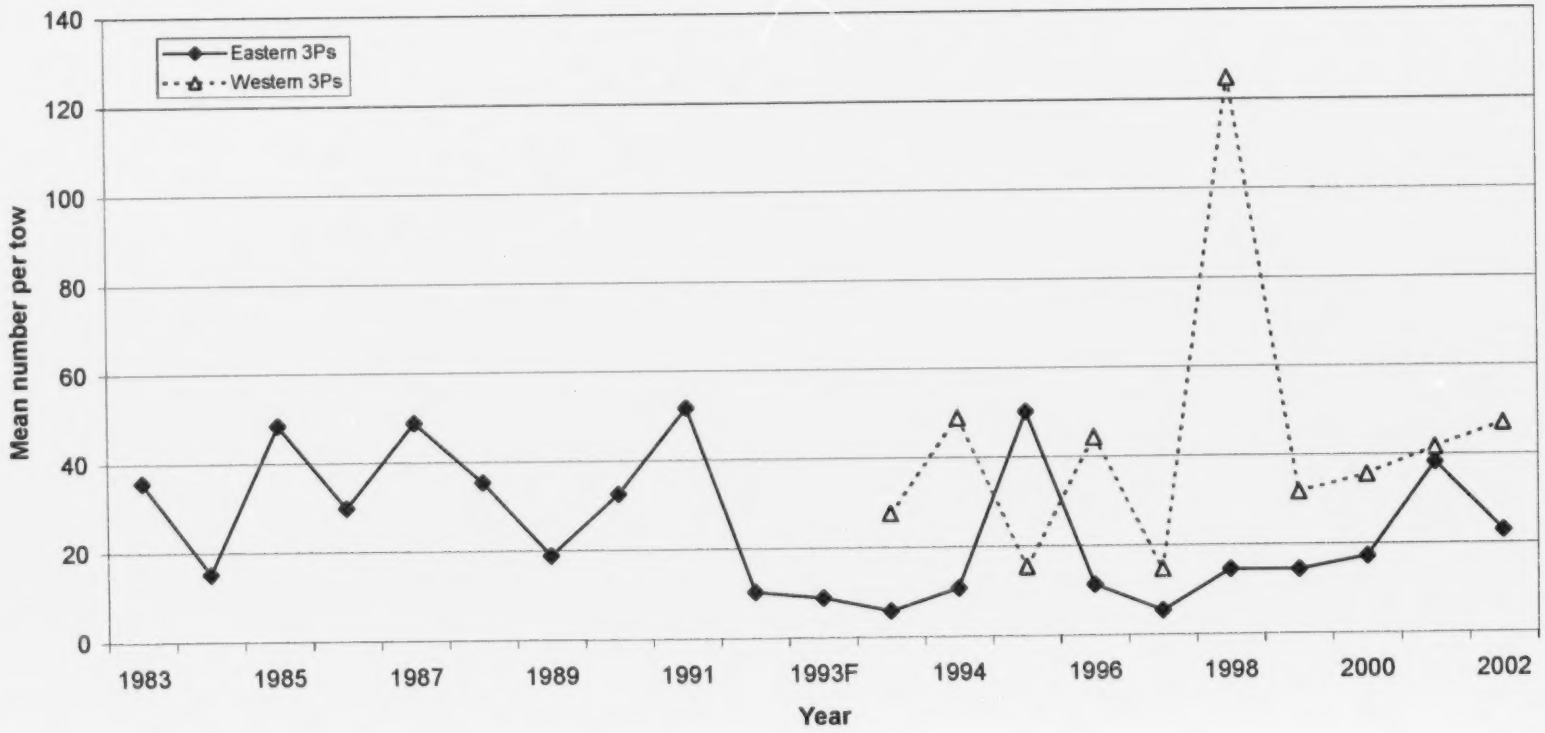

Fig. 13. Catch rate index for the eastern and western (Burgeo area) portions of 3Ps from the DFO research vessel bottom-trawl surveys. There were two surveys in 1993.

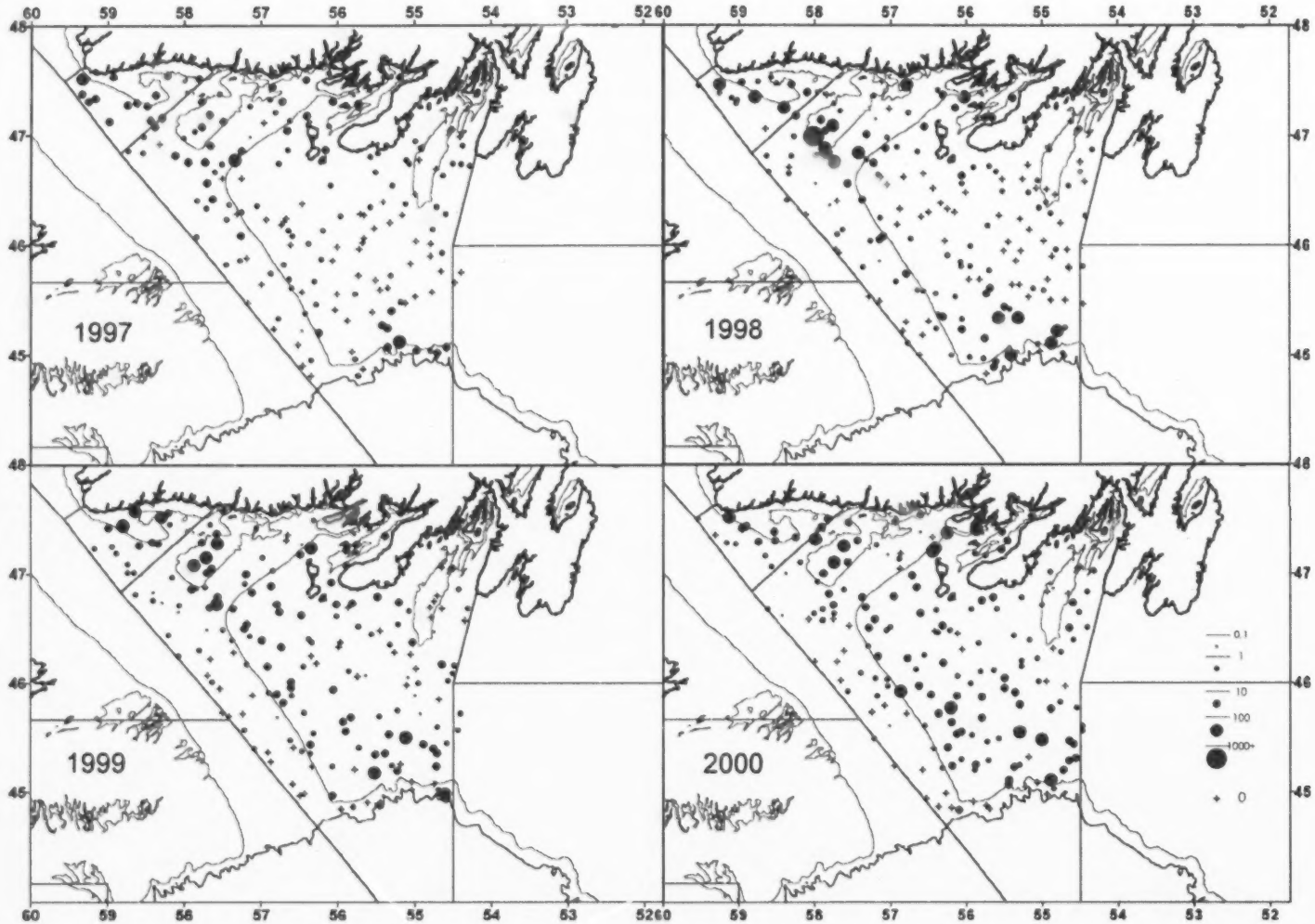

Fig. 14. Distribution of cod catches (number per tow) during DFO research vessel trawl surveys in NAFO Subdiv. 3Ps during April 1997-2000.

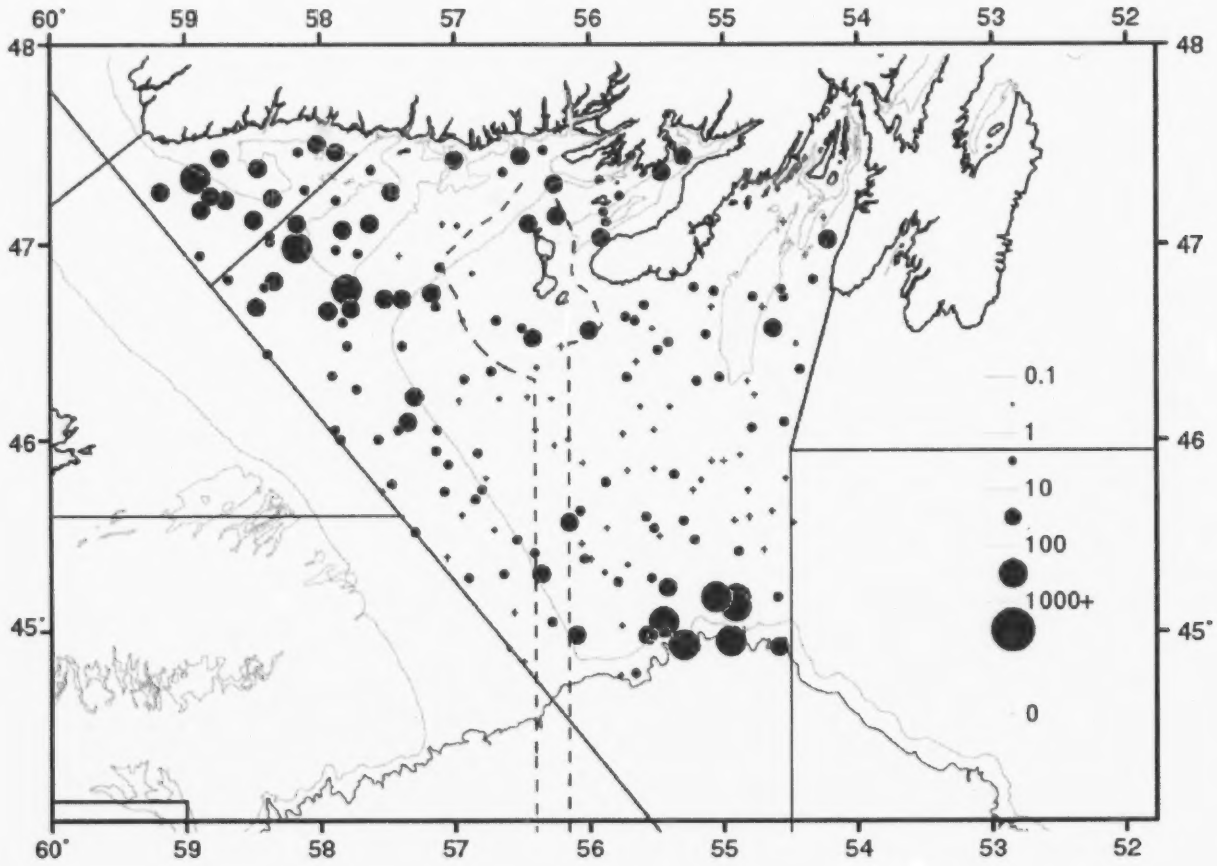

Fig. 15. Distribution of cod catches (number per tow) during DFO research vessel trawl surveys in NAFO Subdiv. 3Ps during April 2002.

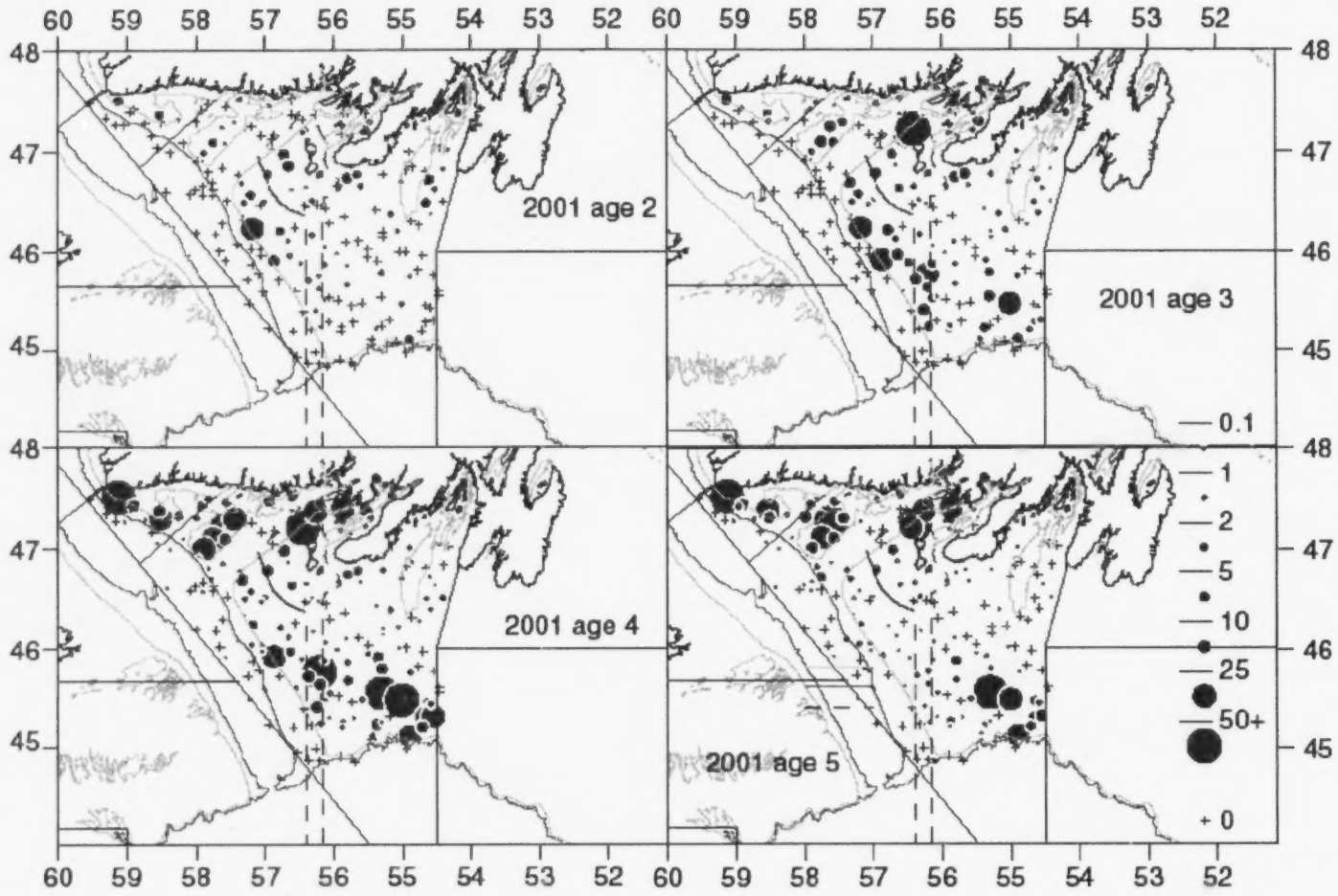

Fig. 16. Distribution of cod catches (number per tow) by age (2-5) from Canadian research vessel trawl surveys in NAFO Subdiv. 3Ps during April 2001

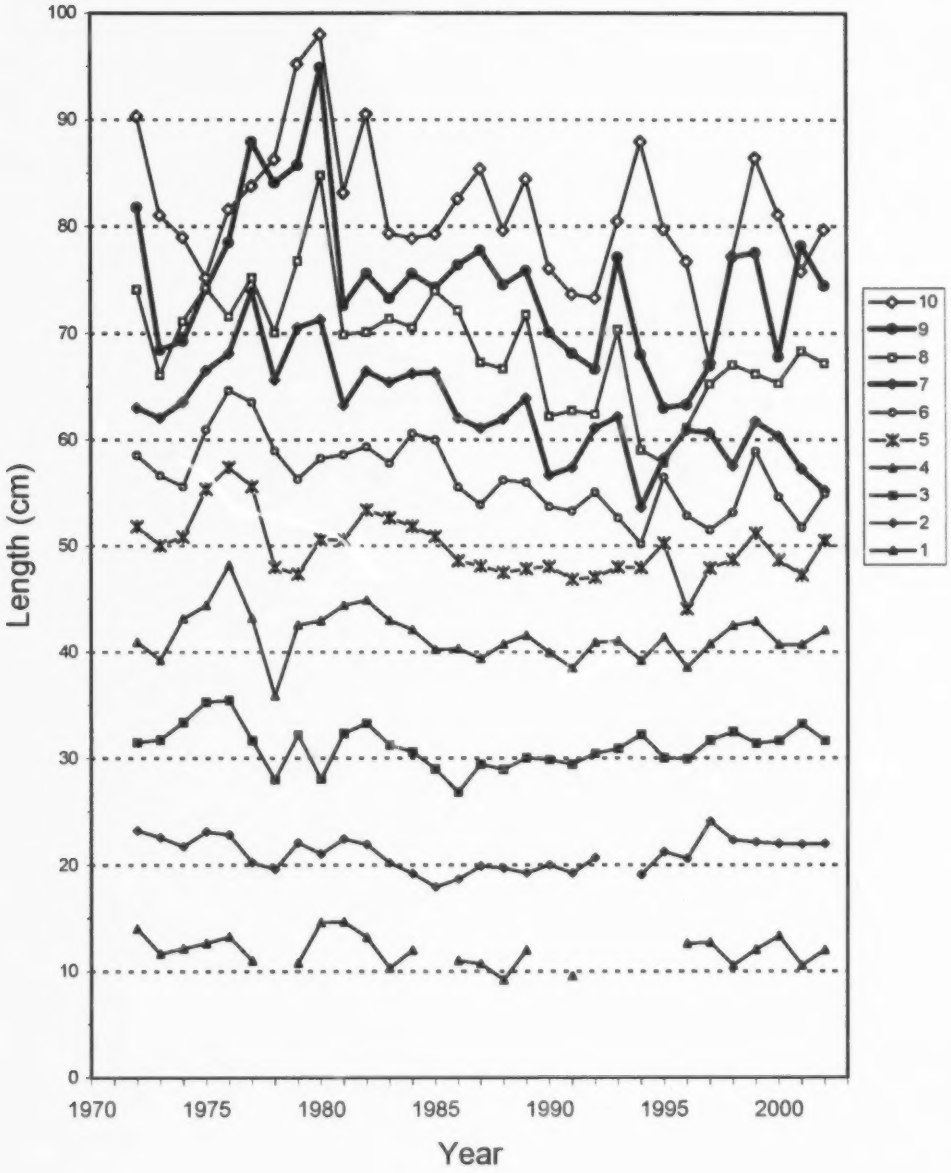

Fig. 17. Mean length at ages 1-10 of cod in NAFO Subdiv. 3Ps during 1972-2002, as determined from sampling during DFO bottom-trawl surveys in winter-spring.

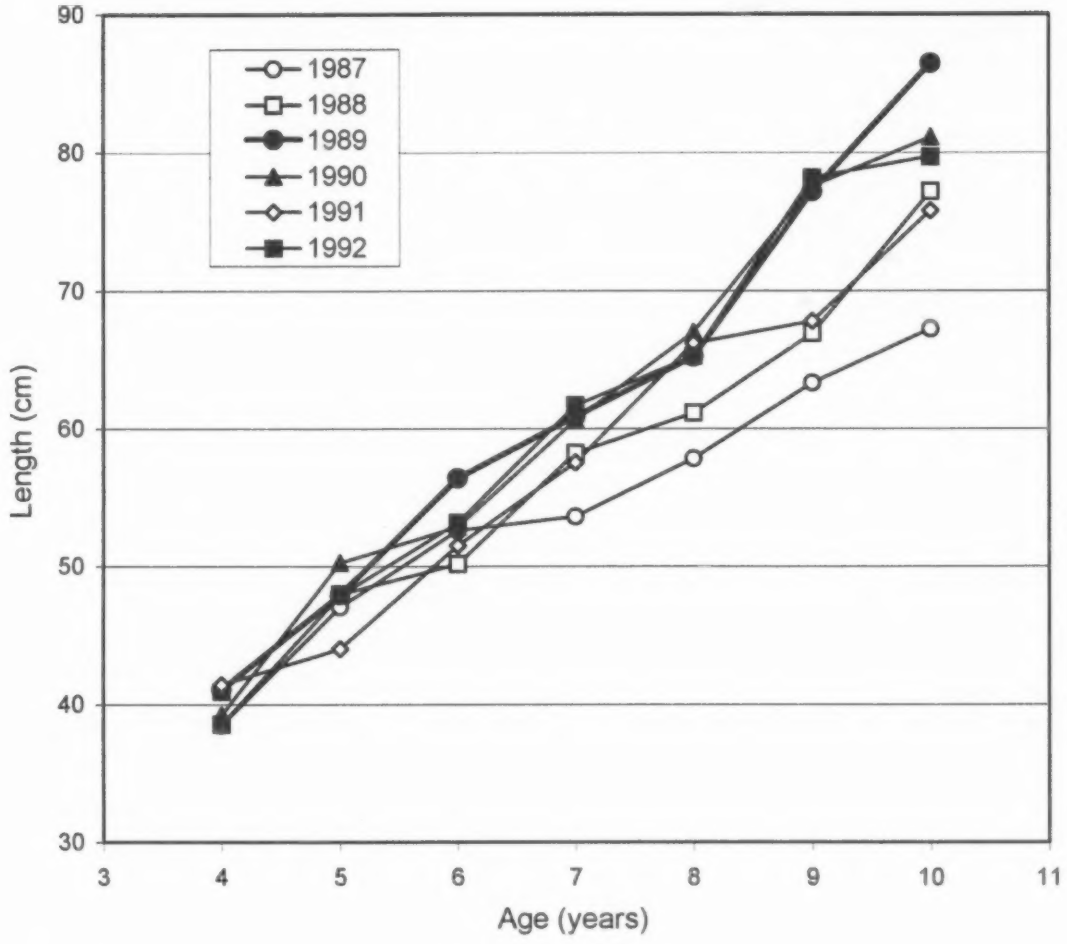

Fig. 18. Mean length at ages 4-10 of the 1987-1992 year-classes, as determined from sampling during winter-spring surveys in NAFO Subdiv. 3Ps.

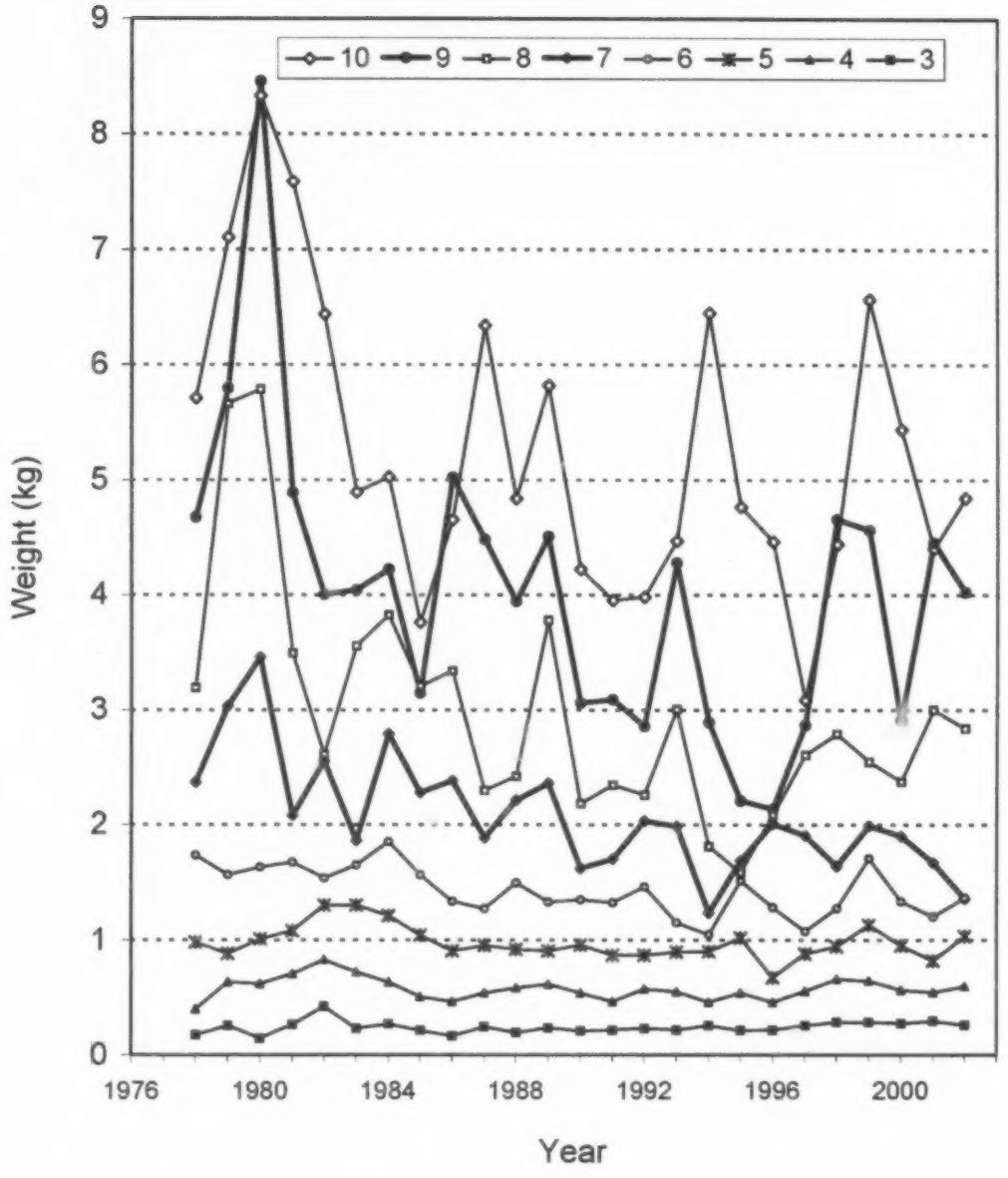

Fig. 19. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in NAFO Subdiv. 3Ps in winter-spring 1978-2002.

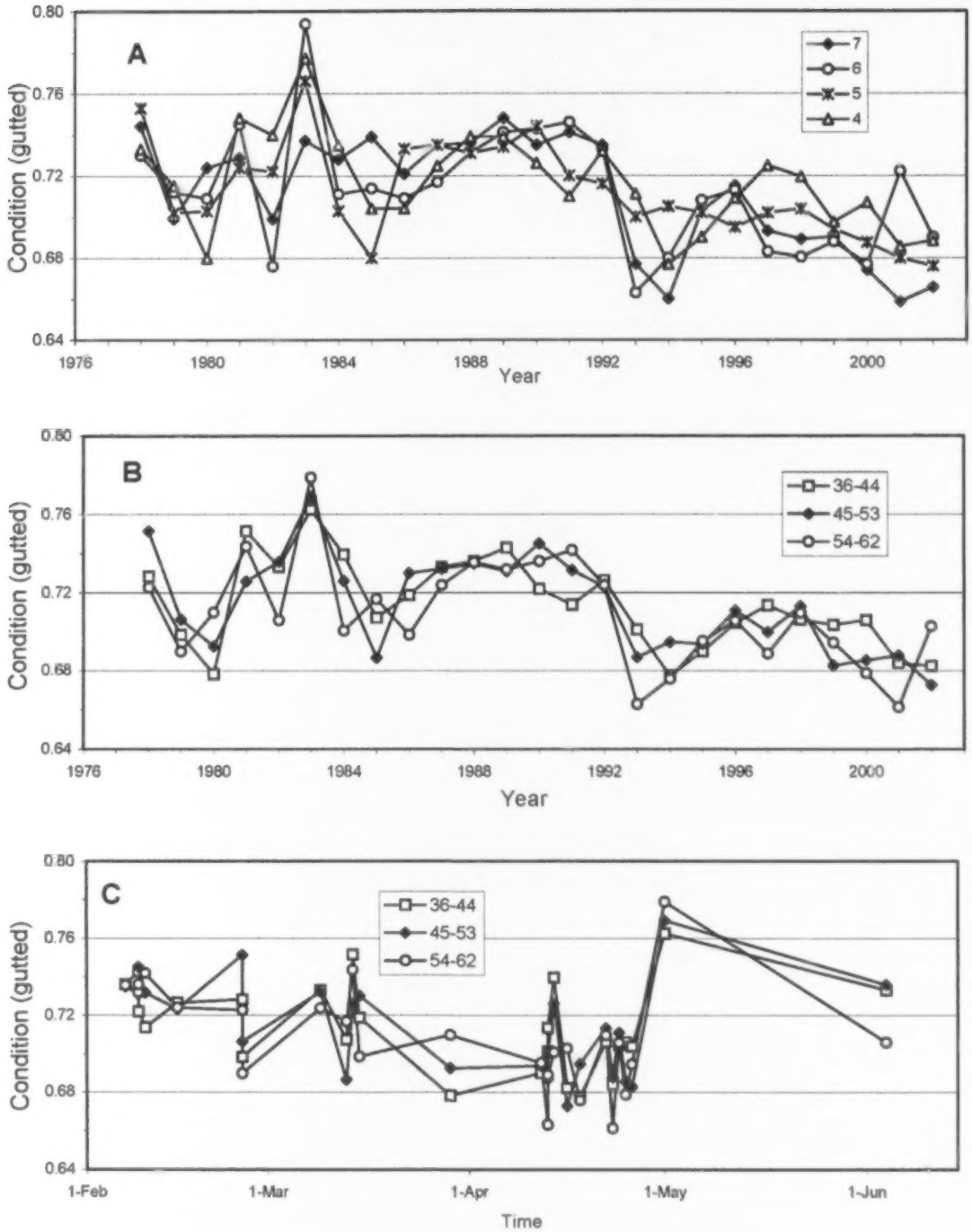

Fig. 20. Mean gutted condition of cod sampled during DFO bottom-trawl surveys in NAFO Subdiv. 3Ps in 1978-2002; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.

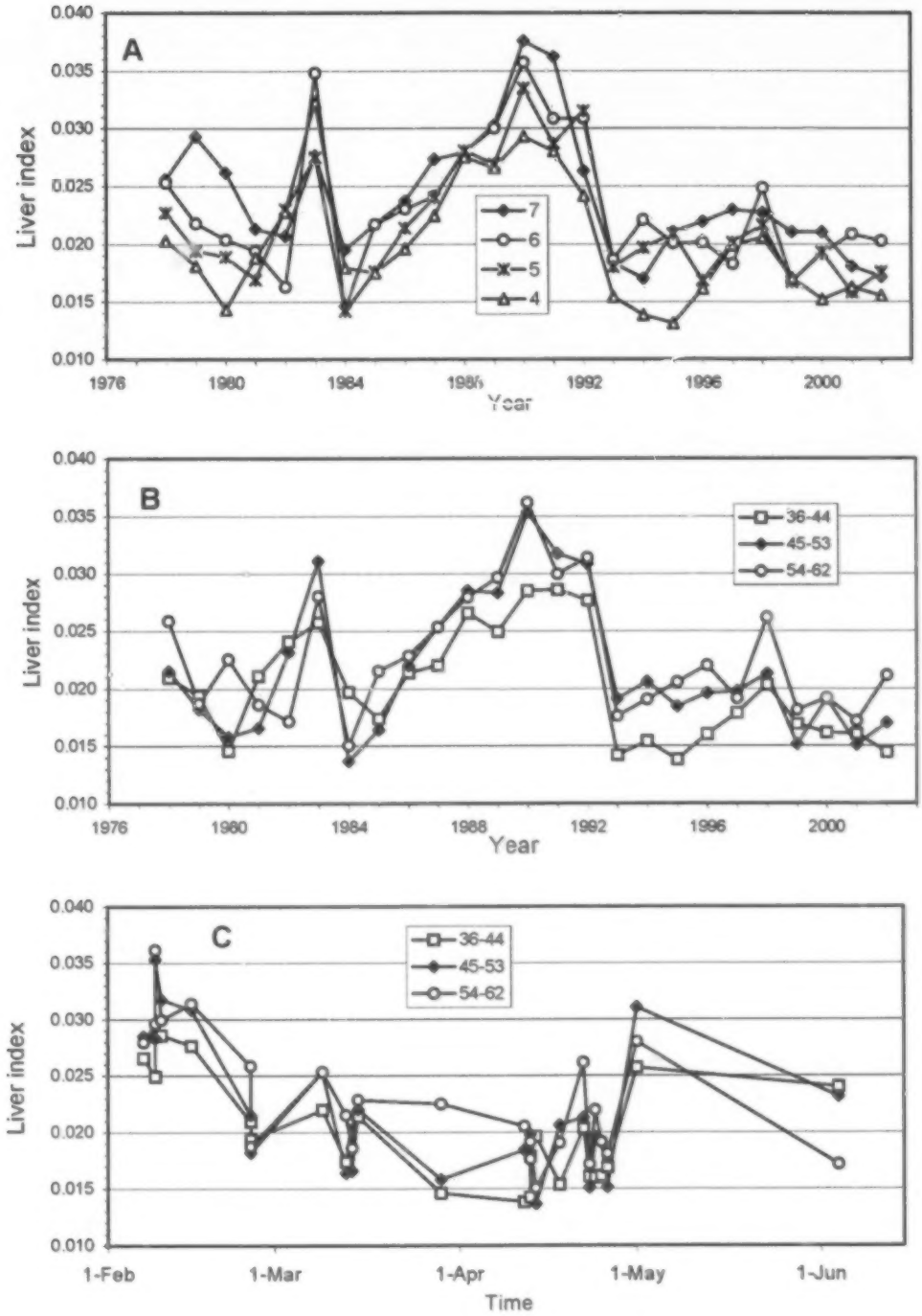

Fig. 21. Mean liver index of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2002; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.

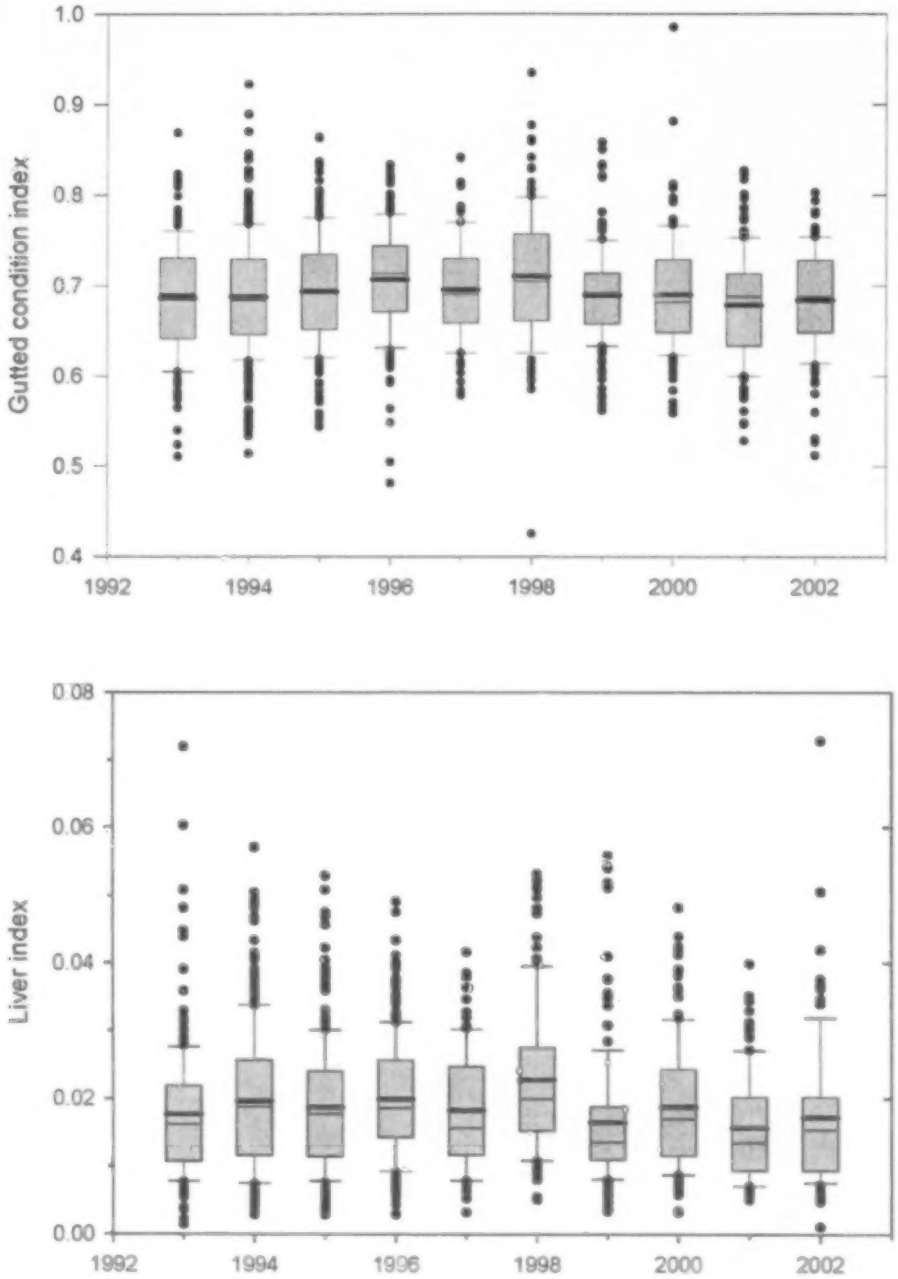

Fig. 22. Gutted condition (above) and liver index (below) of cod caught during DFO research surveys during April in 1993-2002. Each box plot illustrates the median (light line), mean (dark line), 25th and 75th percentiles (box), 10th and 90th percentiles (whisker caps) and all data beyond the 10th and 90th percentiles.

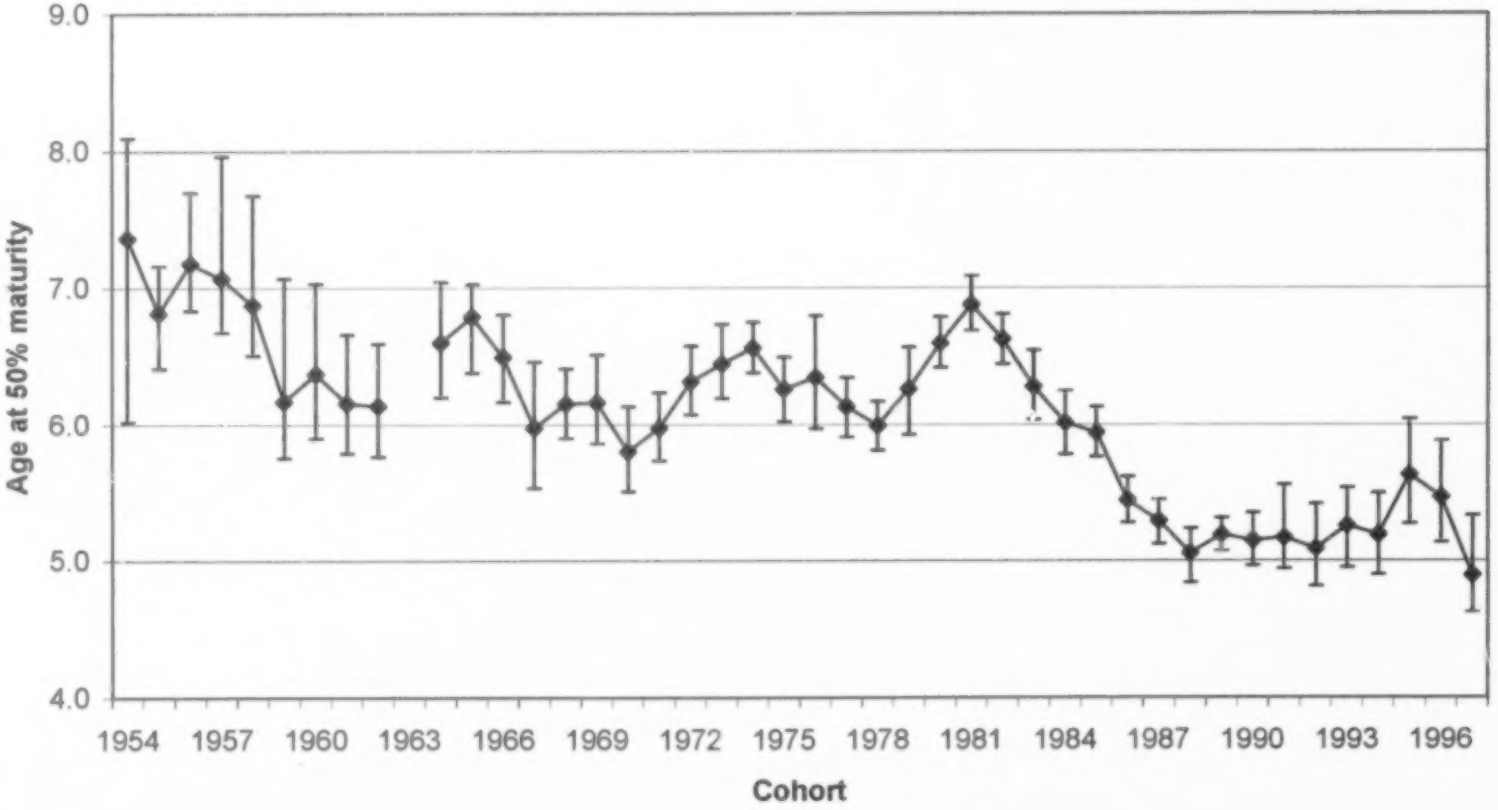

Fig. 23A. Age at 50% maturity by cohort (1954-1997) for female cod sampled during DFO research vessel bottom-trawl surveys of NAFO Subdiv. 3Ps. Error bars are 95% fiducial limits.

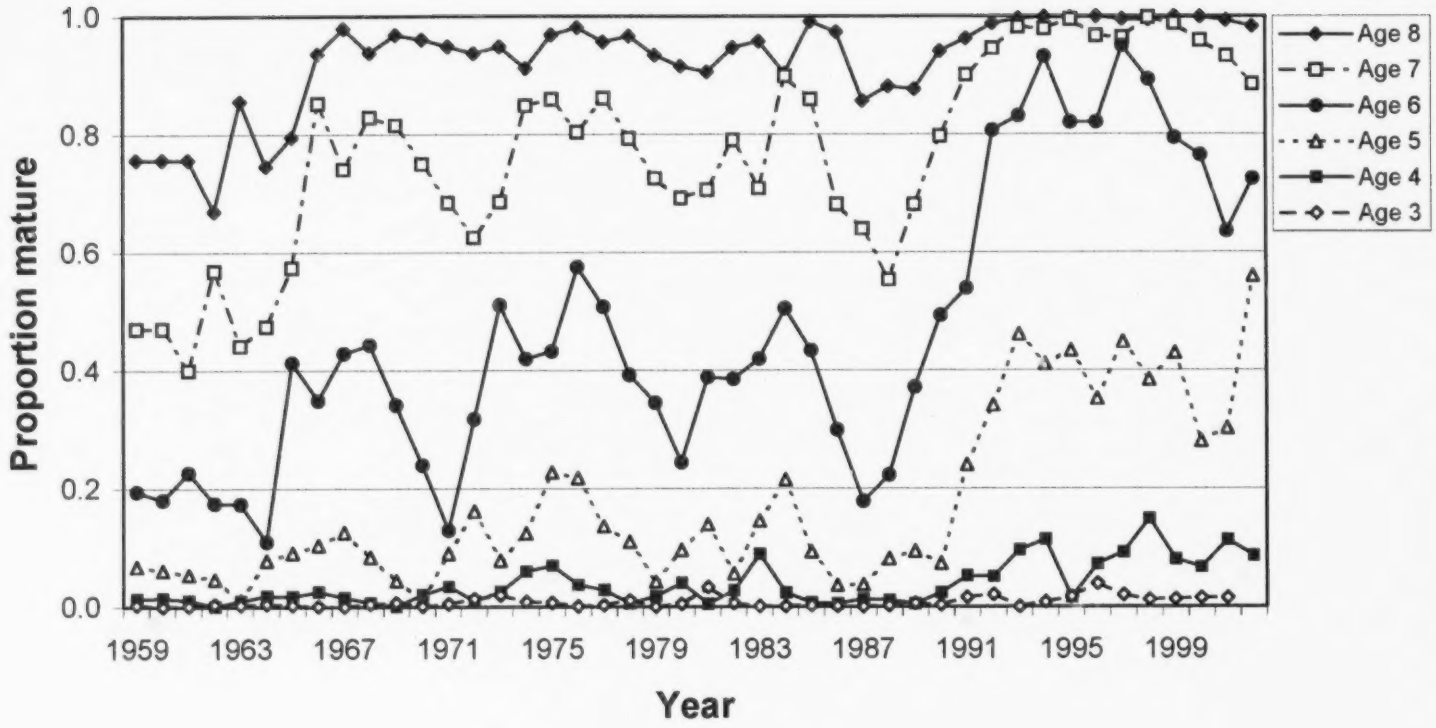

Fig. 23B. Estimated proportions mature at ages 3-8 for female cod sampled during DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps during 1959-2002.

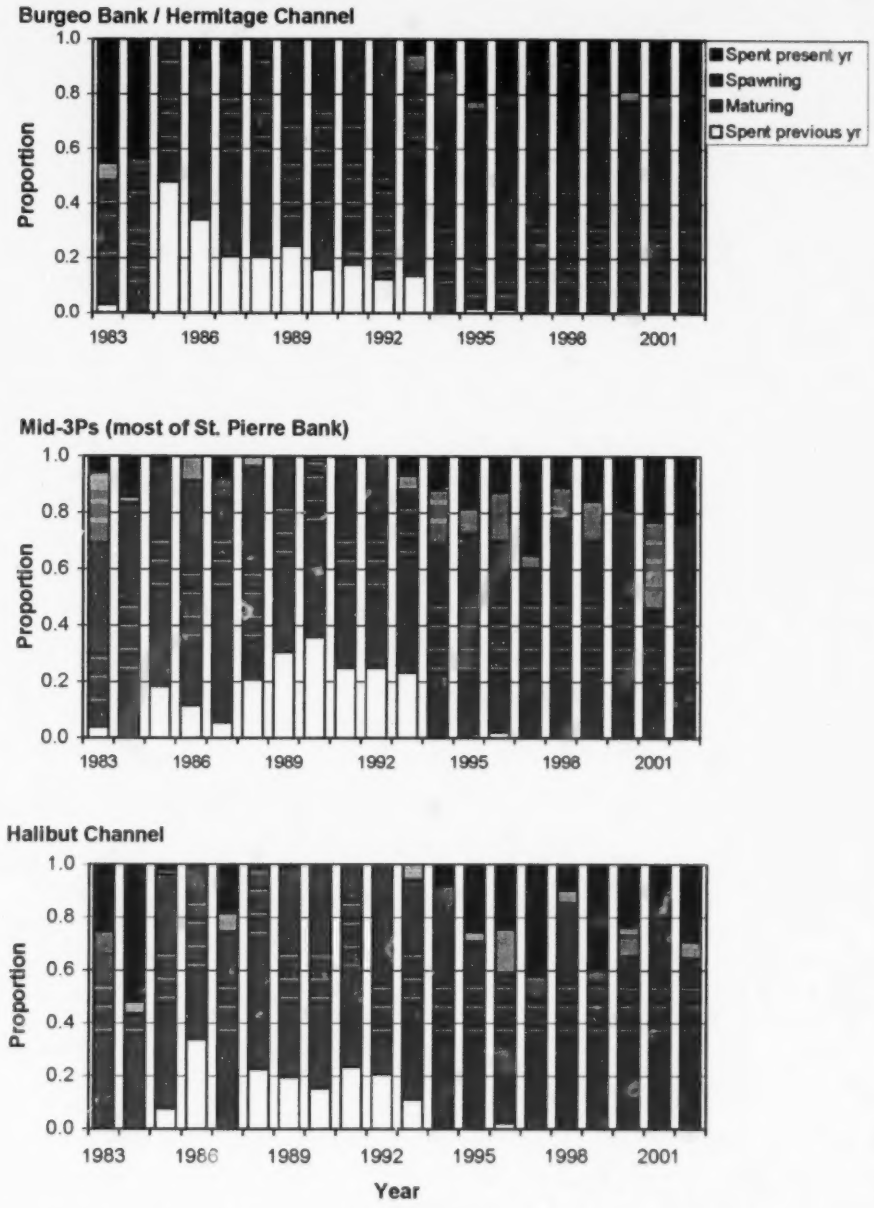

Fig. 24. Maturity stages of adult female cod sampled during DFO research vessel bottom-trawl surveys in three areas of 3Ps during winter/spring 1983-2002. There were two surveys in 1993 (Feb. and April); only the April one is shown here. Surveys were conducted in April in 1983, 1984 and 1993-2002 and in February-March in intervening years.

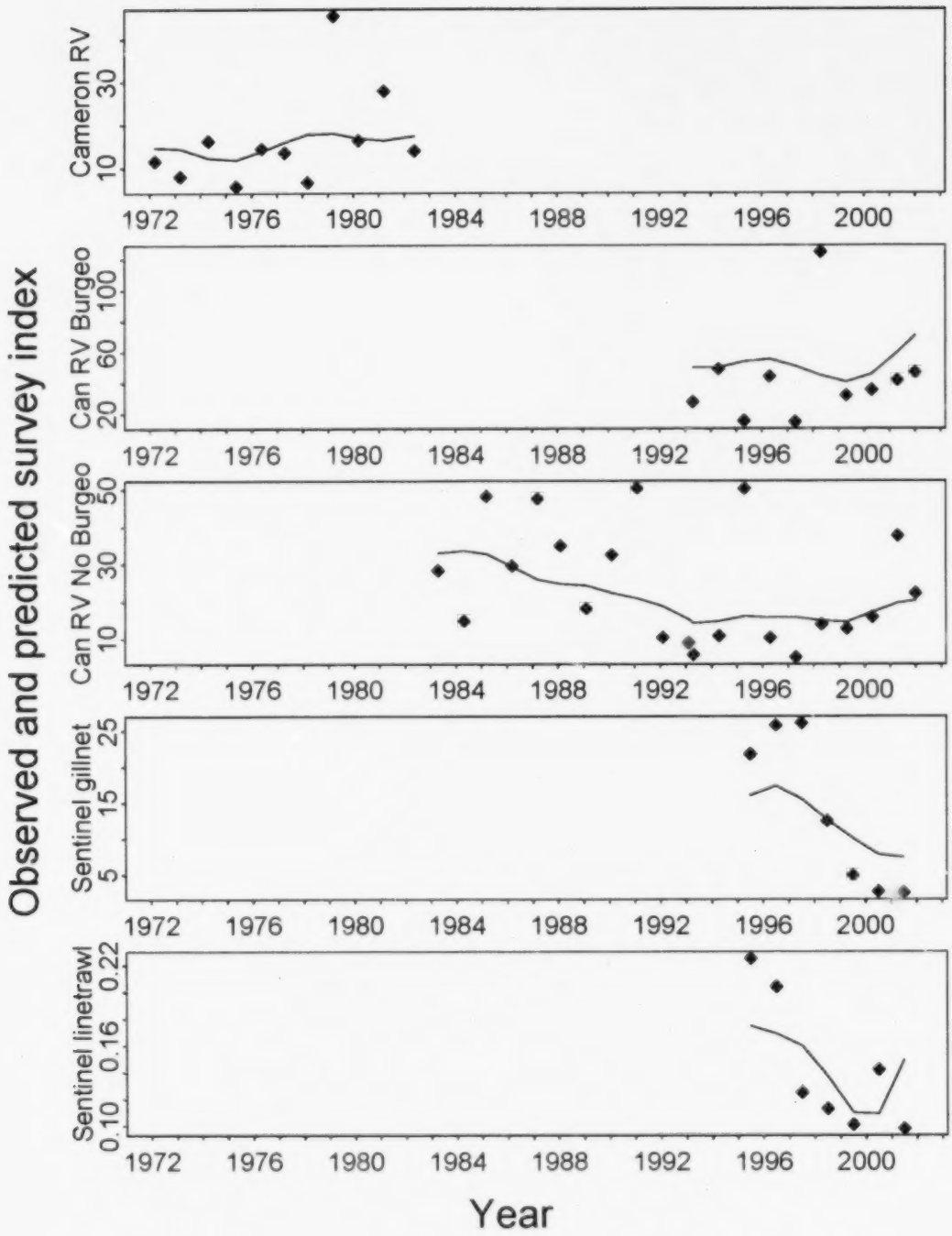

Fig. 25. Graphical output from the QLSPA comparison run (Run A) for 3Ps cod during the October 2002 assessment of 3Ps cod.

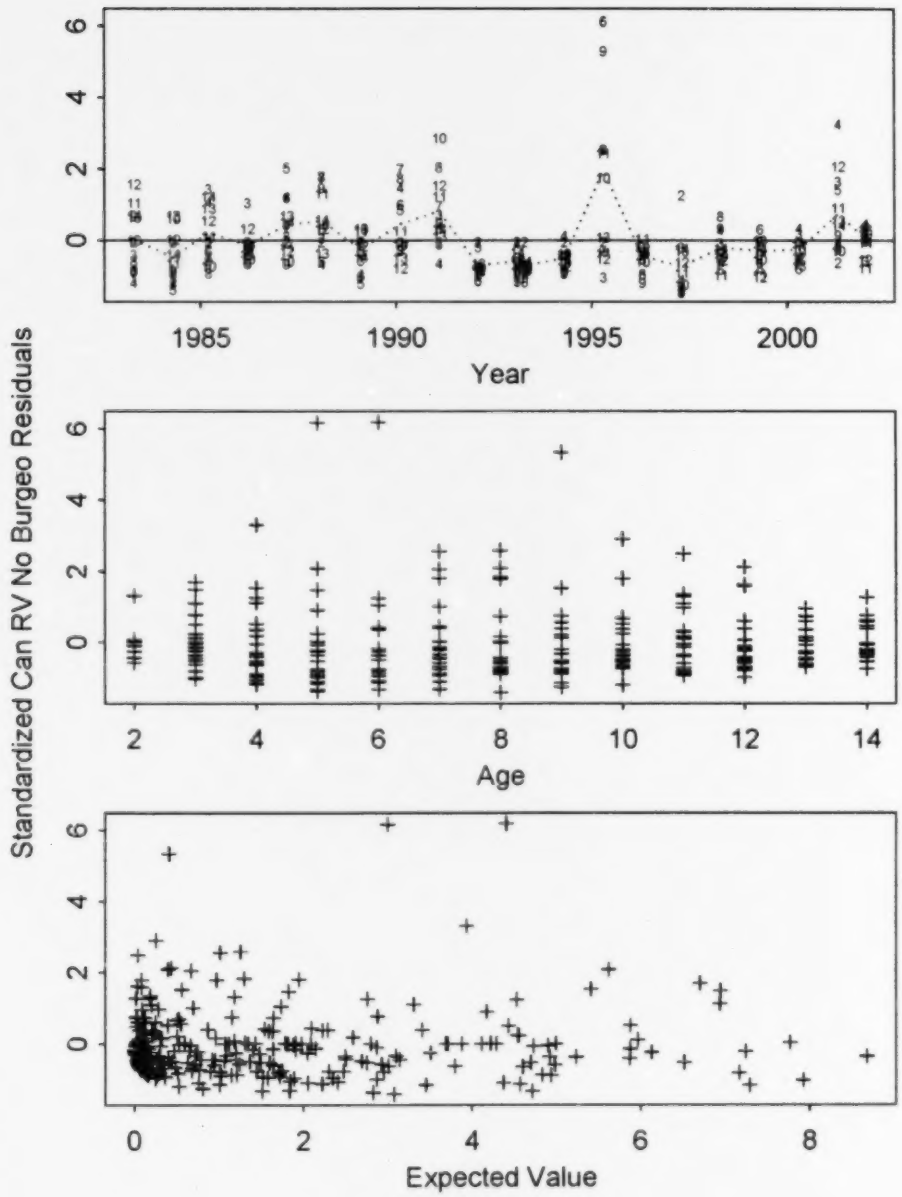

Fig. 26. Residual plots for the survey index from the eastern portion of 3Ps from the comparison SPA run (Run A).

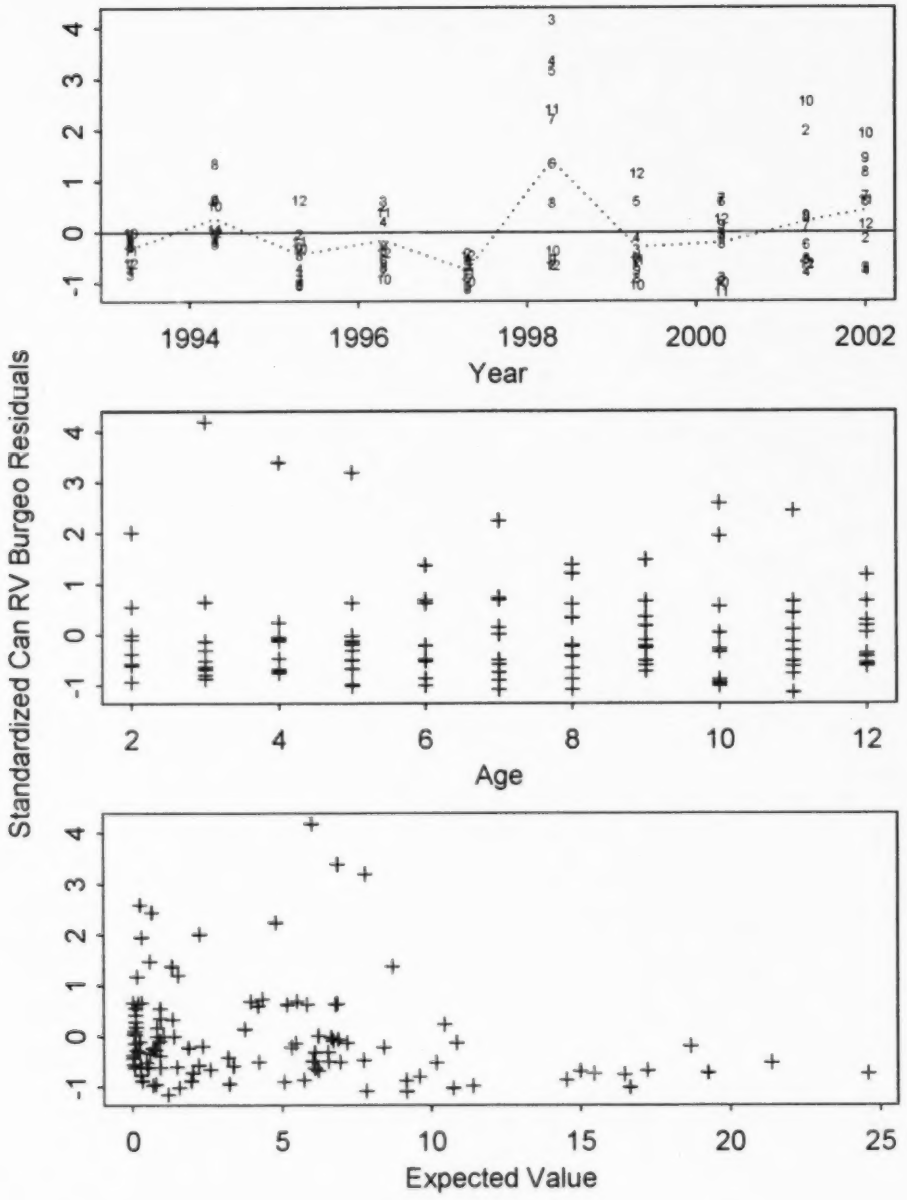

Fig. 27. Residual plots for the DFO research vessel survey index from the western portion of 3Ps (Burgeo area) from the comparison SPA run (Run A).

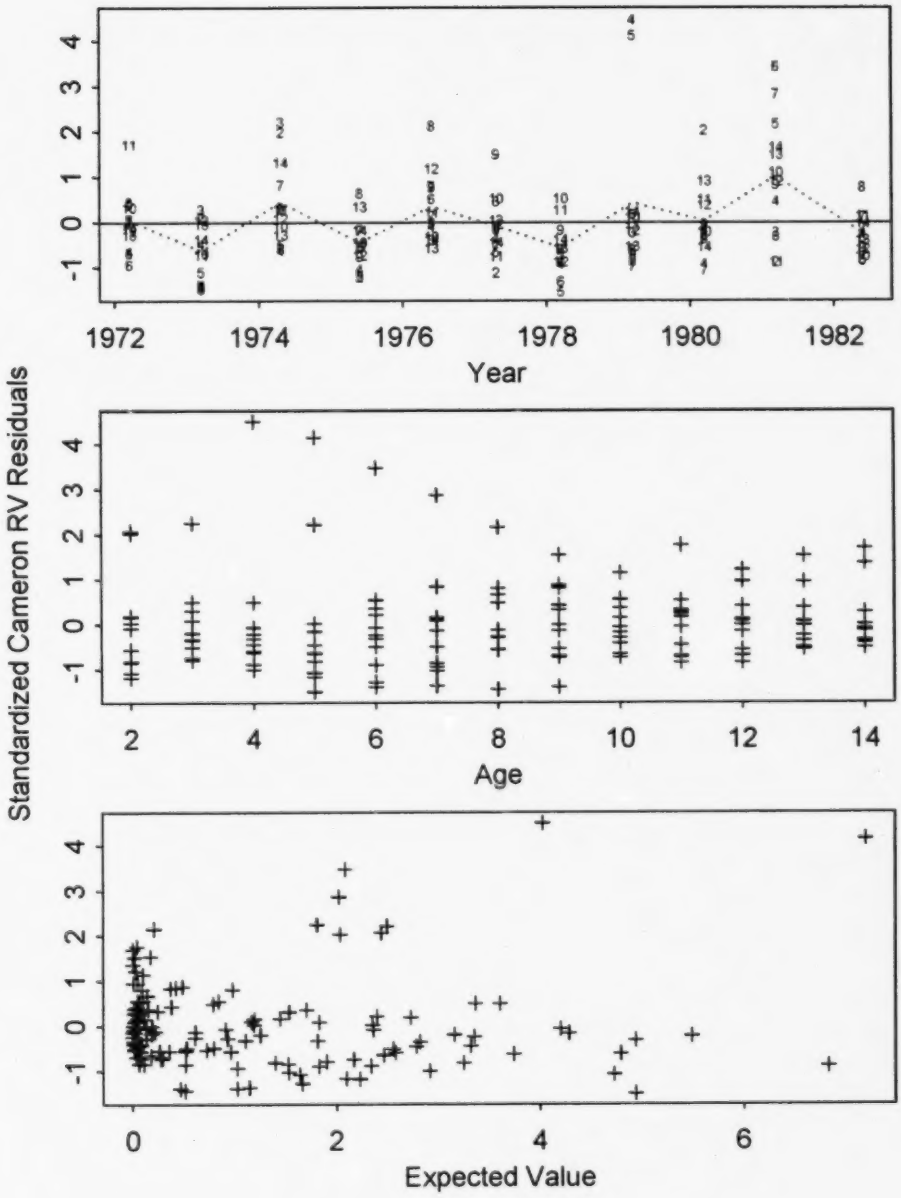

Fig. 28. Residual plots for the RV Cameron survey index (eastern portion of 3Ps) from the comparison SPA run (Run A).

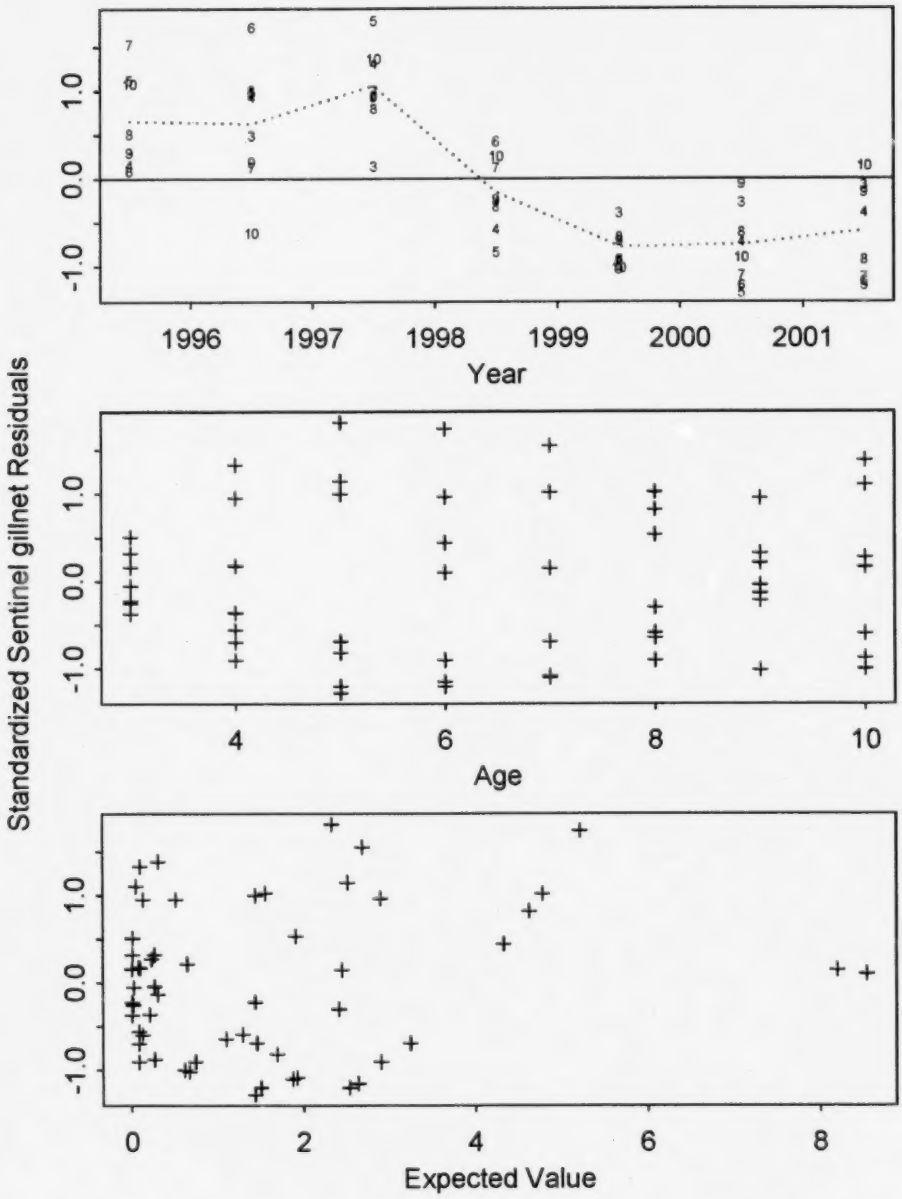

Fig. 29. Residual plots for the sentinel gillnet index from the comparison SPA run (Run A).

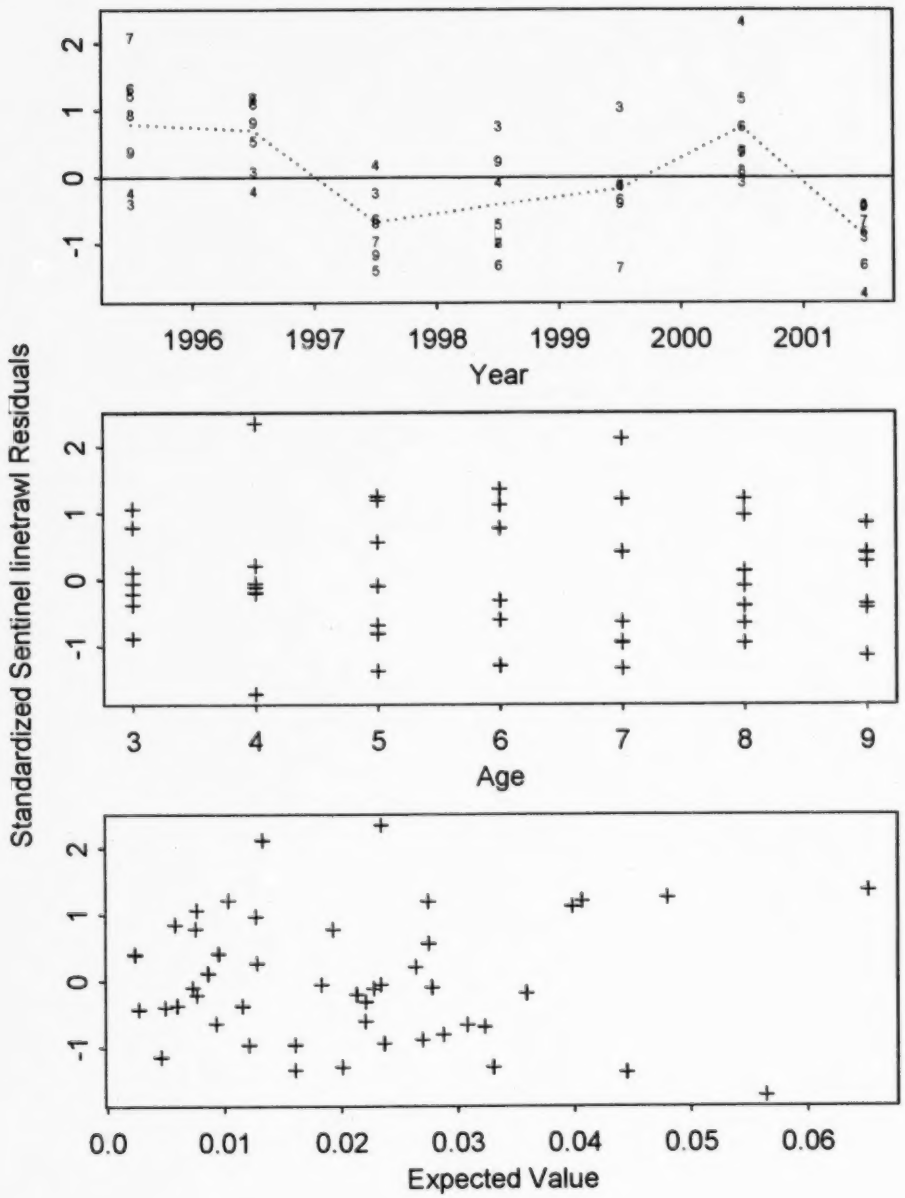

Fig. 30. Residual plots for the sentinel linetrawl index from the comparison SPA run (Run A).

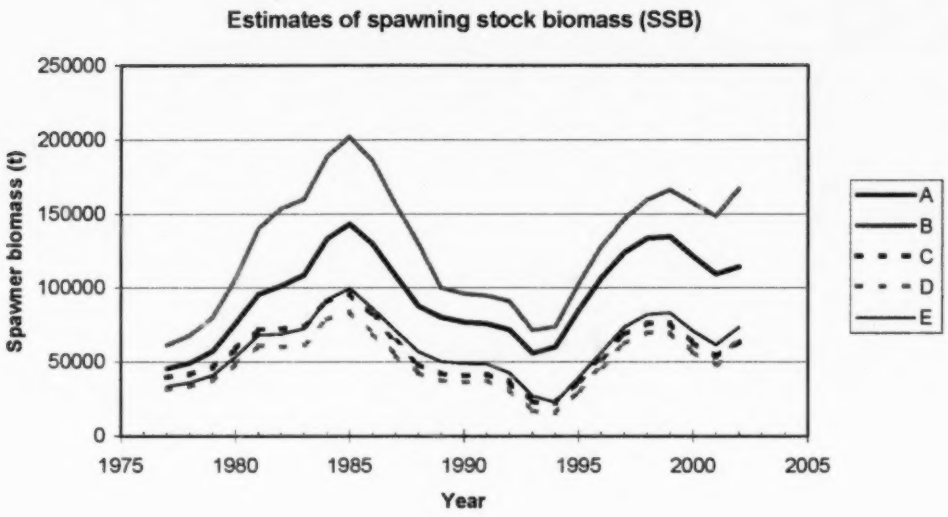

Fig. 31. Comparison of the estimates of SSB from the five SPA model/formulations considered in the October 2002 assessment of 3Ps cod.

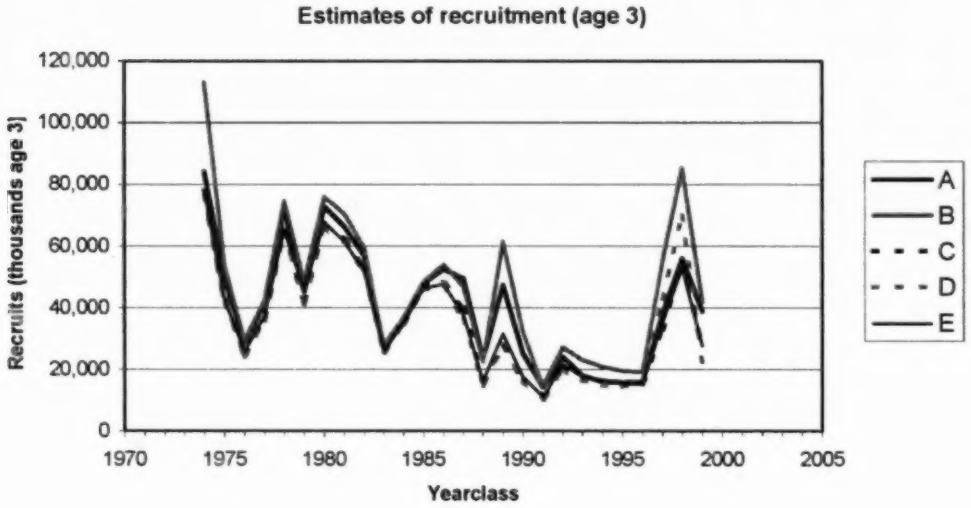

Fig. 32. Comparison of the estimates of recruitment from the five SPA model/formulations considered in the October 2002 assessment of 3Ps cod.

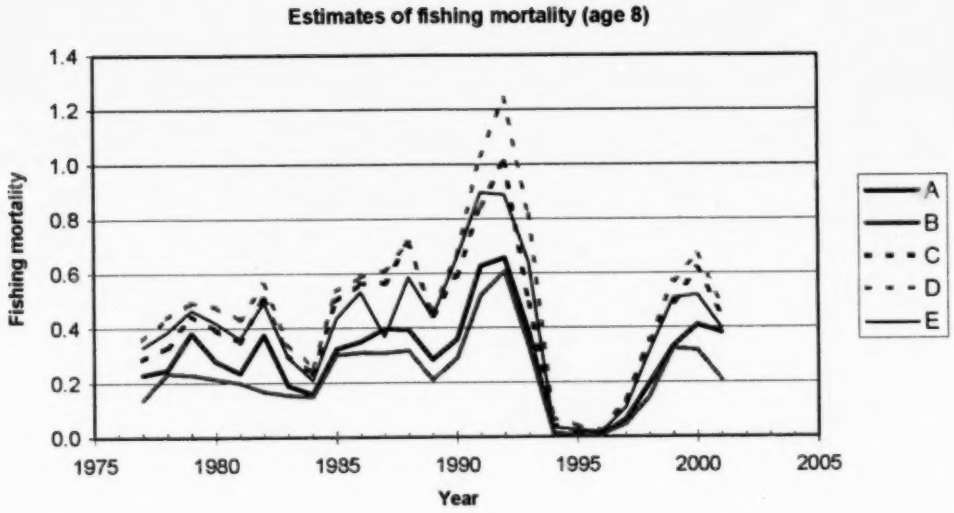

Fig. 33. Comparison of the estimates of fishing mortality from the five SPA model/formulations considered in the October 2002 assessment of 3Ps cod.

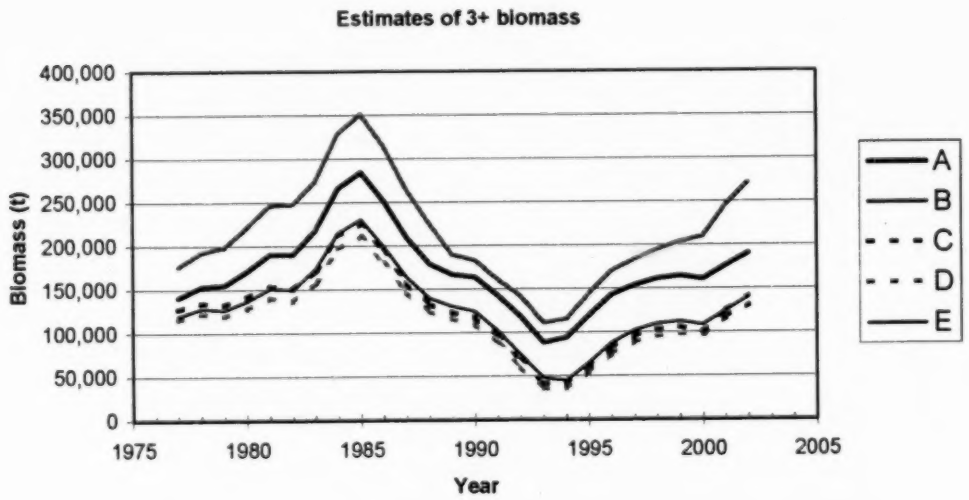

Fig. 34. Comparison of the estimates of 3+biomass from the five SPA model/formulations considered in the October 2002 assessment of 3Ps cod.

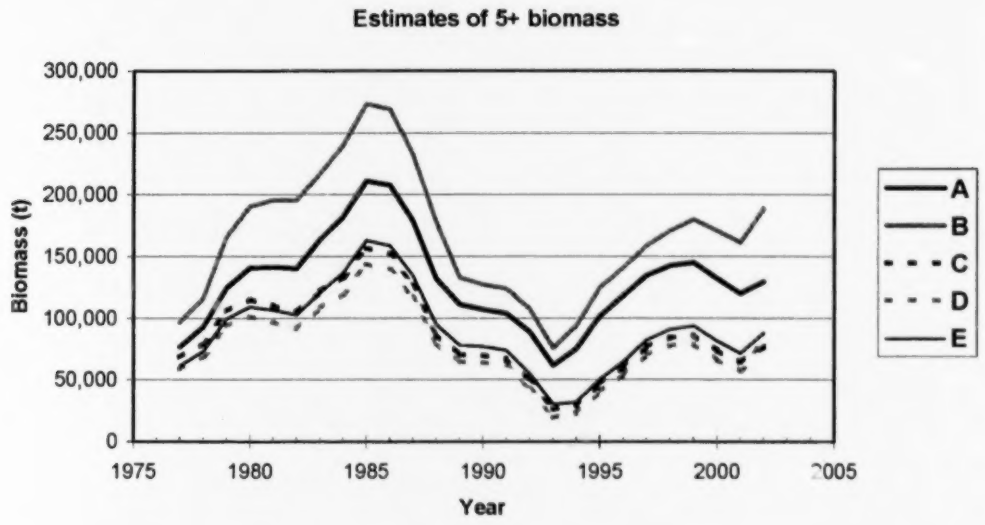

Fig. 35. Comparison of the estimates of 5+ biomass from the five SPA model/formulations considered in the October 2002 assessment of 3Ps cod.

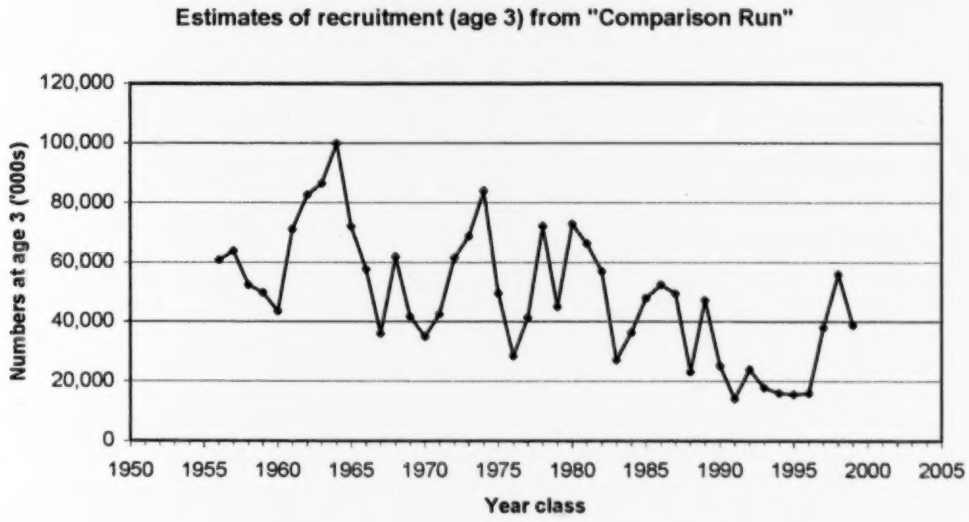

Fig. 36. Comparison of the estimates of SSB from the comparison run (Run A) considered in the October 2002 assessment of 3Ps cod. Note that the time series extends back to the 1956 year class.

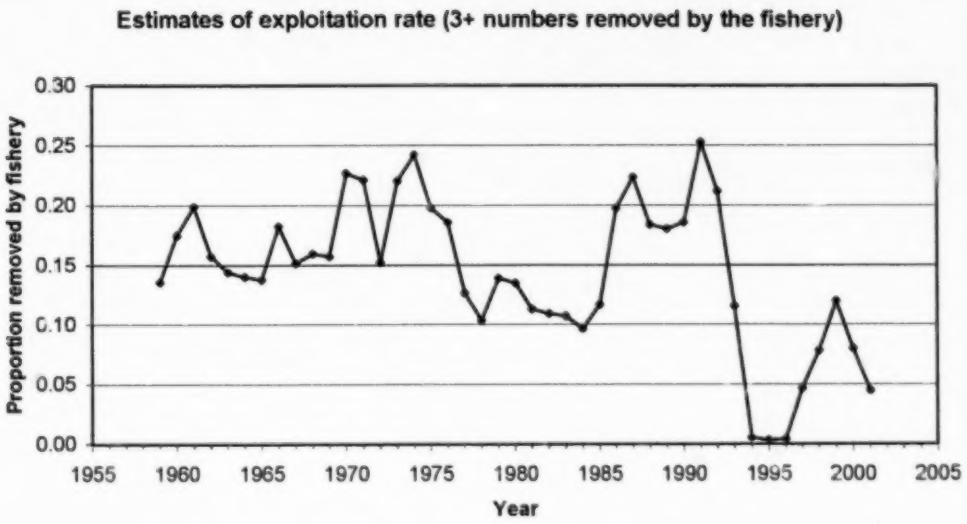

Fig. 37. Estimates of exploitation rate from the comparison run (Run A) from the October 2002 assessment of 3Ps cod.